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CONTENTS.

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Dyestuffs and Applied Organic Chemistry.

THE tourney at Westminster on Dec. 4 was a joyous passage of arms in which the lances of the knights of Cobden dominated in the House of Commons, and champions of dyestuffs were driven from the lists. The ten years' chapter of protection is ended; those worthy burghers of the textile industry who, with the chains of foreign dye merchants round their necks, knelt before Lord Moulton and prayed for deliverance, have forgotten their cry of 'never again'! Fortunately, an amendment was carried in the House of Lords on Monday to extend the Act for twelve months in order there may be a full and impartial investigation into the state of the dye industry. At the eleventh hour, therefore, it is possible that the subject will be taken from the slough of politics and considered in the light of ascertained knowledge.

It is opportune to inquire from a scientific point of view what the real effect of the Act has been, entirely apart from its financial benefit to the small group of dye-makers, who indeed have in the main devoted their profits to research—£700,000 during the operation of the Act in the case of the best-known firm, which is still spending at the rate of £80,000 a year upon it. Above all else, the Act has brought into existence virile schools of organic chemistry which have rendered it possible for our young men to be trained in this subject, to make it their profession, to gain experience in its application to industry, so that they in their turn may originate, invent, and take a leading part in the establishment in Britain of new industries based on organic chemistry.

Twenty-five years ago our organic chemists were few in number and mostly trained abroad; the excellent facilities provided being made possible by the demand for organic chemists by the foreign dyestuffs industry, then in the heyday of its most active development. The opportunity for their employment in industry at home was scanty and the reward small; such organic industries as Britain had were only just holding their own.

During the War, when for the first time the country was thrown wholly on its own resources, the need for the organic chemist soon became apparent and extreme. Right well did the few men who were available, and the hastily trained juniors and even seniors, succeed in extemporising to fill the national needs, so that when peace ensued the nation as a whole followed willingly and with some degree of understanding those leaders who in their wisdom declared that Great Britain

must have its own flourishing, vigorous, successful organic industry, and that dyes, fine chemicals, and the like should be protected and cherished.

At once a new, attractive career for our youth had arrived; the universities were not slow to provide facilities, nor did the young men delay to utilise them. The dyestuff industry in particular readily absorbed at first all the talent available; it is common knowledge that there is no better training ground. In course of time many passed out of it again to other branches of applied organic chemistry, so that to-day Great Britain has—let us repeat, as a direct consequence of the Act—a large and growing force of experienced middle-aged organic experts, of young men occupying junior posts in the industry, and of younger men training specially for such. All are capable of understanding the potentialities of their subject, the speed at which it is developing, and are convinced of the need of Britain more than holding its own in this field if we are not to stand aside from the most promising section of future industrial advance.

Should by any chance the dye-making industry be allowed to languish in Britain, it will inevitably involve also the loss by us to the foreigner of such allied consuming industries as those of lakes, pigments, and printing inks. Ultimately, and at no distant date, we may expect to lose also the dyeing industry and the speciality sections of the textile industry itself. The manufacture in Britain, as the outcome of extensive research, of the newer, more expensive colours has resulted invariably in a reduction of price, whereas those colours which are not yet made here are maintained by the importer at relatively high prices. Much has been made by representatives of the textile industry of the alleged fact that the operation of the Dyestuffs Act has denied them access to the novelties, or at least delayed their making use of these, but they overlook how easy it will be in the future for the foreign dye-maker either to withhold his specialities altogether from the British textile customers or only to supply them at an excessive price or under such onerous conditions as, for example, an agreement to buy their whole range of dyes from him. Indeed, it will not be difficult then to build up a dyeing industry abroad, under the wing of the foreign dye-maker, supreme in quality and price, and having first or sole access to the novelties, to which factory British-made goods would have to be sent to be dyed—a step so disastrous that it is easy to foresee that it would be followed by the goods themselves being woven abroad.

Does the textile industry realise that rayon is only the first of the synthetic textile threads—the product of the organic chemist—and that it will inevitably be followed by others having novel properties, bringing with them new problems of handling or of dyeing? Is Manchester prepared to stand aside from all such developments? Why is it that the need for scientific research in modern life and in modern industry is so much more difficult to bring home to politician and people alike in Britain than in any other country? Germany owes the position its industry has attained almost entirely to its appreciation of science; America since the War owes its progress not to mass production, not to financial plethora, but to the same appreciation by president and people alike of the need for invention, new methods, new ideas, the inextricable linking of scientific research with ever vital and progressive industry within its boundaries. The great industries in the United States—minerals, canning, oil, automobiles, agriculture—are alike in that in each of them there is that alliance between the chemist and the manufacturer which spells progress. Yet the House of Commons strikes a damaging and disheartening blow at this alliance, and one calculated to cripple an industry which, as a training ground alone, should be preserved, apart from the fact, which even its critics admit, that it has made good in its own field. Too much has perhaps been made of its achievements, for, as those actually engaged in the industry know, there is still much to be done, much that is difficult and costly, yet withal is attractive, as well as promising of new successes.

Britain, a small country in area, densely populated, is sadly deficient in natural resources; we have scarcely any water power, no mineral oil, no cotton, cannot grow wheat or cattle in competition with the prairies, have no oil-bearing seeds. The chemist alone can come to our rescue, and, by effecting syntheses of the materials we need from the materials we have, can assist in restoring prosperity to our manufactures and also provide employment for the population. The whole of human life is but the transmuted rays of the sun—food, clothing, nearly all that we use, are but the transformations of its energy. The organic chemist is learning at an ever-increasing rate how to guide such transformations of carbon compounds into ways which are of immediate advantage to mankind, but meanwhile he must be trained and employed. That nation will be foremost in the future which has the most and best trained chemists; above all, the nation with the clearest, sanest chemical outlook.

Newcomen and Triewald.

The Newcomen Society for the Study of the History of Engineering and Technology. Extra Publication No. 1: *Marten Triewald's Short Description of the Atmospheric Engine*, published at Stockholm 1734. Translated from the Swedish, with Foreword, Introduction and Notes. Pp. xxii + 61. 12*s.* 6*d.* net. Extra Publication No. 2: *R. D'acres's The Art of Water-Drawing.* Published by Henry Brome, at the Gun in Ivie Lane, London, 1659 and 1660. With Introduction and a Diagram by Rhys Jenkins. Pp. xxiii + 43. 7*s.* 6*d.* net. (Cambridge: W. Heffer and Sons, Ltd., 1928 and 1930.)

OF all the features which distinguish the present age from those of the past, none is more striking than that of the extended application of power to every need of man. The Egyptians, Greeks, and Romans depended on the work of tens of thousands of slaves—we to-day depend on coal and oil. The discovery of how to produce power from the combustion of fuel must therefore ever rank as one of the great landmarks in the progress of civilisation, and the inventor of the first practical steam engine, Thomas Newcomen, as one of the world's greatest benefactors. That Newcomen but applied the discoveries of others; that he invented neither the cylinder, the piston, the beam, nor the pump incorporated in his engine, detracts nothing from the merits of his achievement. He it was who solved a problem which had long exercised men's minds, and by so doing set on foot the great power industry of the present age.

Whatever our debt to Newcomen, however, it is unfortunate that we know comparatively little of his life and character. Such material as exists relating to him is of a meagre description, and even in the matter of his engine we are dependent on the writings of others. In these circumstances, it was a happy inspiration of the Newcomen Society to publish as their first "Extra Publication" a translation of Marten Triewald's "Description of the Fire- and Air-machine at the Dannemora Mines", a work which has long been regarded as a classic in Swedish technical literature and was the first book ever written devoted solely to the steam engine. Originally published at Stockholm in 1734, some time after Triewald had returned from his ten years' sojourn in England, it has now been translated by Mr. Are Waerland, and printed with a foreword by Mr. Carl Sahlin and a critical introduction by Mr. Rhys Jenkins, together with a bibliography of Triewald's writings.

Newcomen was born in 1663 and died in 1729; Triewald was born in 1691 and died in 1747. A man of great energy and ability, Triewald also possessed self-confidence and a firm belief in an overruling providence. Coming to England in 1716, he made the acquaintance of the scientific writer and lecturer, Desaguliers, and it was probably from him that he gained his first information on the new atmospheric engine. Among those erecting atmospheric engines at this time was Nicholas Ridley, of Newcastle, and Triewald's chance came when Ridley, "led by the wonderful foresight of God", asked Triewald to assist him. Thus embarked on an engineering career, Triewald afterwards formed a company with young Calley, the son of Newcomen's colleague, for the construction and supervision of fire-engines, and immediately after returning to Sweden in 1726 proposed to the shareholders of the Dannemora mines the erection of the Newcomen engine which is described in his book. Triewald, however, appears to have been more successful as a lecturer and writer on scientific matters than as a constructor, for the Dannemora engine was not a success and the shareholders became involved in a long correspondence and a lawsuit.

The book itself is divided into fifty paragraphs, some devoted to personal details, some to scientific theories, some to engine details, and some to suggestions regarding the uses of the engine. In this connexion it is worth observing that Triewald was probably the first to suggest using steam for pumping out a dock. At Carlscrona was the finest dock in the world, but when it was desired to dock a man-of-war, it required the services of 600 men for three days and nights to get rid of the water. An engine, Triewald says, would empty the dock in 8 or 12 hours. The engine could also be used for grain- and saw-mills, tilt hammers, for draining marshes, and for blast furnaces; but whatever it was put to, "the fire-machine is not only a tool, whereupon a very great force is brought to bear, but also the means by which this force is created, so that it can be said with good reason that all the other artifices compared to the fire-machine are merely simple tools which a craftsman is using".

The Newcomen Society has since published as its second "Extra Publication" a reproduction of R. D'acres's "The Art of Water-Drawing" of 1659, the first book in the English language on the raising of water. Only a few copies of the original work are in existence, and though of great interest, it has hitherto escaped the notice of writers generally.

Though written so early, D'acres, whose identity cannot be traced, had a good idea of the action of the atmosphere, and his work contains descriptions of bucket pumps, lift pumps, force pumps, and also of an apparatus for sucking water from wells by obtaining a vacuum by condensing steam in a somewhat similar manner to that adopted in the modern pulsometer. A conjectural sketch has been made of the apparatus by Mr. Jenkins, who for D'acres's book, as for Triewald's, has written the introduction.

New Physiology.

Human Physiology. By Dr. F. R. Winton and Dr. L. E. Bayliss. With a Chapter on The Physiology of the Sense Organs, by Dr. R. J. Lythgoe. Pp. xiv + 583. (London: J. and A. Churchill, 1930.) 15*s*.

CONCERNING the Statue of Liberty in New York Harbour, Clemenceau is alleged to have remarked that the French people also had memorials to the illustrious dead. During the past few years there have appeared several revised editions of the standard works on human physiology used by medical students fifteen or twenty years ago. The changes necessitated by the rapid strides which physiology has made during the intervening period are extensive; and the advisability of putting so much new wine into old, if illustriously old, bottles is questionable. In chapter after chapter a short postscript on the discovery of an oxygen is added to a lengthy exposition of a phlogiston hypothesis. In the mind of the student who approaches his studies in this way confusion is inevitable. In the labyrinth of Nature the path of scientific discovery is often tortuous. One expedition after another ends in a cul-de-sac, from which the inquirer must needs retrace his footsteps and make a fresh start. To the philosopher and student of scientific method such reverses are meat and drink. They only bewilder the beginner.

Winton and Bayliss have produced a text-book in which they have set out to expound what is known about physiology to-day. They have not encumbered their exposition with a catalogue of the mistakes of our illustrious predecessors. They have not assumed that the time devoted to elementary zoology is exclusively confined to architectural mnemonics intended to recall the foramina of the dog's skull or the pontifical polysyllables associated with the appendages of the crayfish. From the first to the last page they have confined themselves to the kind of information which a medical student who has surmounted the stile of the first professional examination may reasonably expect from a course of physiology bearing directly on the practice of medicine. The information is presented with lucidity and good humour. The book is a highly creditable performance. The authors are to be warmly congratulated on their task.

Apart from the rapid progress of physiological science during the past few decades, there are several extrinsic reasons which prompt a demand for a new tradition in the teaching of medical physiology in Great Britain. One is the new temper in British zoology. A generation of younger professors, including Dr. D. M. S. Watson, himself a distinguished palæontologist, are insisting that zoology, as its name implies, is the study of animals rather than corpses. Consequently, it is becoming possible to relegate the experimental anatomy of the organs to an earlier stage in biological instruction. Under the influence of Dr. Charles Singer the history of medicine is rightly asserting its claims to rank as an independent branch of study. There is therefore less need to subordinate the inclusion of vital contemporary issues to the historical presentation of the individual sciences. Winton and Bayliss have wasted no space in 'flogging dead horses'. They have made no attempt to deal with those aspects of physiology which have developed more particularly in connexion with the study of the lower organisms and may now be safely entrusted to the teaching of experimental zoology. They have succeeded in writing a book which is suitable for the medical student, omits nothing which is of vital interest to the present generation, and spares no effort to familiarise the reader with laboratory methods and experimental data on which modern physiological principles rely. Their presentation of the new work on muscle and nerve, reflex action and the special senses, endocrinology and reproduction, shows that there is room for a higher standard in medical instruction so soon as those engaged in teaching physiology are willing to devote less attention to effete themes and superannuated topics.

Throughout the book there is a careful attention to the definition of terms. On page 1 we are reminded that "health and disease are primarily sociological concepts", a truism overlooked by many physiologists and by nearly all psychiatrists and eugenists. The phraseology is felicitous, and the authors consistently encourage those "who have acquired the rare faculty of being able to suspend judgment without undue discomfort to take the opportunity to exercise it". In dealing with the special senses and with the mechanism of behaviour

the writers adhere to a strictly objective nomenclature more rigidly than the authors of earlier works. The remarks upon speech are an exception to their general practice. No one will disagree with the statement that "such relations have not yet been analysed in objective terms" (p. 446). Their statement that "considerable progress has been made in this field by the methods of introspective psychology (*e.g.* psychoanalysis)" is open to the objection that, if any conceivable progress in such matters is due to professional psychologists who still adhere to an introspective terminology, it is because they have actually employed methods analogous to those which the physiologist uses.

American Oil Fields.

Structure of Typical American Oil Fields: a Symposium on the Relation of Oil Accumulation to Structure. Forty Special Papers including a Critical Summary, in part from the Program of the Twelfth Annual Convention of the American Association of Petroleum Geologists at Tulsa, Oklahoma, March 24, 25 and 26, 1927. Vol. 2, 1929. Pp. xxiii + 870 + 4 plates. (Tulsa, Okla.: The American Association of Petroleum Geologists; London: Thomas Murby and Co., 1929.) 27*s.* net.

THE origin, migration, and accumulation of petroleum: three outstanding episodes (in proper sequence) in a natural history even now imperfectly understood. Every text-book on oil geology gives a chapter to each; every author reiterates the same arguments which have held sway since the enlightened days of Redwood, Engler-Hofer, and their contemporaries. 'Origin', as such, has a literature of its own, much of it unconvincing to a degree. Migration of petroleum is a subject still in a state of flux and kept so by the contradictory results of experiment and conflicting tenets of modern philosophy. 'Accumulation' is the oil-pool itself, how and why it came to be formed, what its relationship to reservoir-rock really proves to be, what its disposition anent structure actually signifies. In the last case we are on more solid ground because the unravelling of subsurface conditions of so many oil fields to such a point of accurate detail has provided us with tangible evidence of the *raison d'être* of many a big pool.

Our American friends enjoy nothing better than to take stock of a situation, scientific or otherwise, preferably by means of large-scale conferences. 'Accumulation' in itself furnishes an excellent theme for one of these debates, which, in published form, occupies two large volumes. This is the second, in matter, style, and presentation similar to the first.

If the reader can wade through the mass of detail given in each of these studies of American oil-pools, his knowledge of accumulation will be almost rare. If detail appals, he may emulate without shame that type of novel-reader who weakly scans the end pages to see if it has a likable ending or plot, or whose patience tires before the half-way chapter; only in the present instance, the last paper, by F. G. Clapp, not only reveals the essence of all that has gone before, but also it is by far the best contribution of all, and, if for no other reason, this volume merits attention. Apart from this, the papers making most appeal deal with such famous pools as Long Beach, California; El Dorado, Kansas; Caddo, Louisiana; Cushing, Oklahoma; Yates, Texas, and Salt Creek, Wyoming; perusal of these is worth while if other sources of relevant information have not previously been consulted.

There are probably few types of oil-pool in the world not amply illustrated by the examples quoted in these two books, and one wonders whether, under the heading of 'accumulation', we have very much more to learn and, be it admitted, to what extent symposia really advance our learning.

H. B. M.

'How it was Made' in Antiquity.

The Technical Arts and Sciences of the Ancients. By Albert Neuburger. Translated by Dr. Henry L. Brose. Pp. xxxii + 518. (London: Methuen and Co., Ltd., 1930.) 42*s.* net.

THIS is a disappointing book, and scarcely worth the great labour of an English translation, or the translator's occasional attempts to patch it up; and as the bibliographies of the German original have been omitted, it is impossible to check or follow up many remarkable statements without reference to it. But considering the immense field which it is designed to cover, and the very defective materials available in many parts, it is a remarkable compilation, and justifies the translator's contention that the achievements of the ancient world have been unduly overlooked in matters not only of industrial technique but also of scientific experiment.

Dr. Neuburger complains that often his predecessors have been insufficiently acquainted either with the ancient languages or with modern experience in the same arts and industries. But his book will perpetuate hardy misconceptions,

on both sides: and some which were already cleared up when he began to collect his material. This is part of the price that a very learned nation has to pay for its prodigious output of *thesis* and *programm*, and for the rapidity with which, in historical studies at all events, wild guesses gain and lose acceptance. A man must be something of a specialist in general knowledge to gather only good grain where there is so much chaff.

Take the chapters in the present volume on metallurgy. What evidence is there that the "Germanic races . . . became acquainted with copper long after they had used iron" (p. 13); that the Phœnicians obtained metallic tin from India (p. 15); that Herodotus "makes special mention" of the Cassiterides (p. 14) except to deny knowledge of them; that the Corinthian clay-tablets depict smelting furnaces (p. 11), not pot-kilns; that Spartan boys played with lead soldiers (p. 19); that the iron column at Delhi is dated to the ninth century B.C. (p. 21), or that iron was worked in India in 2500 B.C., or even in 1500 B.C., or cast-iron in 1400 B.C. (p. 22); that Thothmes III. took great booty in iron spears (p. 22)? The Egyptian furnace in Fig. 24 was not a 'bloomery', but for gold working, as the (omitted) inscription shows. Nor does the iron "generally flow out", or it would be cast-iron and useless to ancient smiths (p. 26); nor is chrysocolla identical with malachite (p. 46); nor galena with lead-oxide (p. 48). On p. 119, it is difficult to see how lead sulphate could result from alteration of black-lead. An Athenian *stater* equalled two *drachmæ*, not four.

The chapters on pottery are not much better. The *crux ansata* (p. 131) is not the same as the *swastika*, nor is either ornament found on "all fired clay of the first-period", nor even, if it were, would it prove that the "cradle of the clay industry" was in Asia Minor or in Egypt—which are really quite different countries. The "art of varnishing glaze" (p. 132) looks like a mistranslation, for *Firniss* includes vitreous glaze; "ordinary clay stones" is perhaps another (p. 132). But the descriptions of the Greek potter's wheel (Fig. 204) and of the technique of 'red-figure' painting are nonsensical. On p. 144 and p. 151 distinct and discrepant accounts are given of ancient "black-glaze", and on p. 142 it is stated that the first object in thus glazing pots was to make them waterproof. That certain colours were "always applied under the glaze" (p. 143) is unlikely, as they would have been invisible.

There are some wrong references to ancient authors, and some queer mistranslations. Of Xerxes' Bridge, the popular rendering of Herodotus vii. 36 is repeated, though a 'science-man' should have detected its absurdity. In the account of "Oils and Fats", on p. 113, "reels" should probably be "tackle", "see-saw" should be "lever"; p. 114, "buttress" should be "clamp", and the whole mechanism is misunderstood. On p. 117, "notch" should be "knot" (as in knot-grass); on p. 118, is "combusting" correct? On p. 464, "stretches" should be "stretchers".

In spite of obvious defects, for popular purposes the book brings together a very large mass of information on a side of ancient life which is in many ways curiously like our own. J. L. M.

Our Bookshelf.

Aircraft Instruments. By C. J. Stewart. Pp. xix + 269 + 30 plates. (London: Chapman and Hall, Ltd., 1930.) 21*s.* net.

ONE'S first feelings upon picking up this book are that here is a volume that deals with the application of a somewhat nebulous physical science to concrete engineering problems, written by an author singularly competent to link up the two subjects. Unfortunately, the subject is not dealt with from that point of view to anything like the extent possible. The author principally confines himself to the description of apparatus and its use, doubtless with an eye upon the size and readability of the book. There are, however, ample references to relevant publications that enable the subject matter to be followed up if desired. The chapter on the measurement of height is a happy exception to this criticism. It is probably the most comprehensive study of this question published to date.

Major Stewart seldom passes opinions upon the instruments described. There is nobody more competent to do so, both by reason of his extensive experience and of the position that he now holds as head of the Instrument and Physics Department of the Royal Aircraft Establishment. For example, in the chapter on compasses, he describes the selenium cell distant reading type. One feels certain that this is an interesting laboratory experiment at present, rather than a practical aircraft instrument.

The book is certainly the most comprehensive description of aircraft instruments that has yet been published. Incidentally, the photographs and diagrams are very well chosen as illustrations to the text, and are not mere padding, as is so often the case. A device in many of the R.A.F. official photographs, of including a portion of a scale, is very helpful in giving an impression of the size of the objects.

The subdivision of the book is logical and easy for reference. The instruments are classified under

their functions, which facilitates their comparative study as types.

The descriptions are not confined to British instruments, all the better-known foreign makes being included. An interesting chapter deals with the methods of measuring actual height above the ground immediately beneath the aircraft. This problem is very much in the minds of aircraft operators, and is by no means successfully solved yet.

The Victorian Tragedy. By Dr. Esmé Wingfield-Stratford. Pp. ix + 296. (London: George Routledge and Sons, Ltd., 1930.) 10*s.* 6*d.* net.

WHY 'tragedy'? One reads Dr. Wingfield-Stratford's new and brilliant book through with growing wonder. He meets so fully all the cheap gibes against the last generation—the ineffectual politicians, the hypocritical moralists, the fainting women, and all the rest of it—and shows the contrary truth of an age of exceptional earnestness, industry, and success—"the heyday of idealism and imaginative genius"; and then sums it up as a "tragedy". What does he mean? Dr. Wingfield-Stratford's answer is that the Victorian middle class was 'tragic' because its members went on their earnest and triumphant way quite unwitting of the catastrophe which was to follow and of the greatest social and industrial problem which remained to be solved. The latter was the humanising of the industrial revolution, the widening of the conquest of Nature which the nineteenth century initiated with scientific machinery into a conquest of human conditions, the addition of an ideal of beauty to that of wealth.

No doubt on this side our Victorian ancestors were defective; but it was they who first proclaimed the need of the change, through Ruskin, Morris, Carlyle, and a host of other prophets and workers. Unhappily, it was a far easier and quicker process to make cotton goods in a factory than happy and intelligent workers in garden cities. The mechanical process outstripped the moral; but it is mere ignorance and ingratitude to overlook the fact that the mechanical conquest of Nature made possible the vast extension of health and well-being of all kinds which the inheritors of the Victorians now enjoy. Dr. Wingfield-Stratford, of course, does not fall into this gross error, and he has given us a book which is delightful to read for its wit, enthusiasm, and good stories, while it constantly raises big questions such as we have discussed above.

F. S. M.

The Fauna of British India: including Ceylon and Burma. Published under the Authority of the Secretary of State for India in Council. Edited by Lieut.-Col. J. Stephenson. *Cestoda.* Vol. 1. By Dr. T. Southwell. Pp. xxxi + 391. (London: Taylor and Francis, 1930.) 22*s.* 6*d.*

THE investigations of the late Sir William Herdman on the pearl fisheries of Ceylon, begun in 1902, suggested infection with larval cestodes as a cause of pearl formation and thus directed attention to the cestode parasites of fishes found in Indian seas. The reports on these by the late Sir Arthur Shipley and Mr. James Hornell were followed by a series of papers by Dr. Southwell, who later turned his attention also to the cestodes of Indian land vertebrates. Since the War a number of other helminthologists have given a good deal of attention to Indian cestodes. Dr. Southwell has now produced the first volume of a monograph which will be found of great value as bringing together the results of all these researches, hitherto scattered in many scientific periodicals.

The volume deals with those families that include most of the fish-infesting species, and contains an introduction giving a useful account of the structure and classification of the group. The illustrations are numerous and excellent. A little more care in the arrangement of the matter would, in some places, have made the book more easy to consult for those who are not specialists. The hasty reader, finding on p. 344, for example, the names *Thysanobothrium uarnakense* and *Parataenia elongatus* standing in black type at the head of paragraphs of description, may waste some time in discovering that these are regarded as synonyms of *Polypocephalus radiatus* described on p. 342. In the preface it is pointed out that "the field is largely unexplored, and it is clear that in the near future additions to our knowledge are likely to be made on a large scale". This desirable result will no doubt be hastened by the publication of Dr. Southwell's volume.

Thomas Aquinas. By Rev. M. C. D'Arcy. (Leaders of Philosophy Series.) Pp. ix + 292. (London: Ernest Benn, Ltd., 1930.) 12*s.* 6*d.* net.

THE extent of the writings of St. Thomas Aquinas and the vastness of his system make it a very difficult task to condense his philosophy within the compass of three hundred pages. Yet Father D'Arcy has succeeded in presenting the fundamental principles of the Angelic doctor's system in a concise and accurate form.

Although St. Thomas shared many of the naïve beliefs of his contemporaries, he was aware of the provisional character of much science and skirted its treacherous sands when he wished to establish a truth definitely. The physical universe as St. Thomas saw it is the one made familiar to us by Aristotle and the Ptolemaic system; nevertheless, he puts in quietly the *caveat* with his cautious "if it be true". So that his scientific beliefs have little bearing on the fundamental aspects of his mental and moral philosophy. Indeed, in revising St. Thomas's teachings, his modern followers have given up with good grace his astronomical beliefs, his theory of the four elements, of the influence of the air and the sun, of motion, of the physical, chemical, and biological conceptions which entered into his philosophy of substance and change. The bibliography at the end of the book shows that much has to be done in Great Britain for the study of St. Thomas, who had, after all, a considerable influence in the Middle Ages. If Father D'Arcy's book awakens the interest of his readers in that direction, his labours will not have been in vain.

T. G.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Molecular Field and Atomic Order in Ferromagnetic Crystals and in Hydrogenised Iron.

THE molecular field postulated by Weiss to explain ferromagnetism is regarded by Becker[1] as mechanical in origin, representing the control exerted by strain within any portion of a crystal upon the direction in which that portion may retain its magnetisation in the absence of externally applied magnetic fields. More recently, Becker and Kirsten[2] have discussed some interesting experiments upon the magnetisation of nickel under tension. They arrive at the conclusion that, at least for applied fields much larger than the coercive force—which becomes as small as one or two gauss under their extreme conditions—the magnetisation may be predicted quantitatively from the maximal magnetostrictive shortening of well annealed metal and the saturation intensity of magnetisation, both of which quantities are sufficiently well known from previous experiments by others. Their account of the effect of internal stresses over the cross-section of a wire specimen upon its magnetisation is also very satisfactory. They point out, in the second footnote to p. 660, that the " extremely irreversible processes " observed in weak applied fields are not correctly represented by Becker's theory, magnetic changes being observed at field values which are less than the theory predicts as necessary for their occurrence.*

Two other recent notes which present apparently contradictory opinions regarding the molecular field are by Frenkel and Dorfman[3] and by Akulov.[4] In the former, the energies of magnetisation and of the quasi-magnetic separation of a crystal into elementary regions magnetised in different directions are used in computing the minimum and average volumes of the magnetically saturated regions postulated by Weiss. In the latter, it is argued that such magnetic saturation of small regions is incompatible with the observed magnetic behaviour of iron macro-crystals, and that therefore the internal energy of partially saturated states must be nearly the same as that of the saturated state.

A fourth position of interest in the present connexion is that taken by Gerlach,[5] who thinks that his own experiments and those of others are consistent only with the complete absence of magnetic hysteresis in perfect crystals of iron. Against this it may be urged that the hysteresis losses in the polycrystalline hydrogenised iron of Cioffi[6] are at least as low as in any mono-crystalline iron yet described.

My recent studies on magneto- and elasto-resistance[7] have led me to suppose that the electrical resistance of a crystal in which the atomic magnets have been rendered parallel by magnetisation or by mechanical strain is sensibly the same whether the magnetic axes of the elementary magnets all point in one direction—corresponding to magnetic saturation—or point indifferently in either direction—corresponding to magnetic neutrality. The two states have been distinguished in a paper before the American Physical Society[8] as, respectively, 'magnetic' and 'mechanical' atomic order. This distinction affords a convenient starting-point for a more precise treatment of ferromagnetism which may lessen the confusion of opinions noted in the papers first referred to herein.

In agreement with Becker, then, we may regard the molecular field of Weiss as wholly mechanical in origin.† Since, however, the strain tensor does not fix the direction of the magnetic vector, we will suppose that a given strain may, in the absence of an applied magnetic field, be associated with any degree of magnetisation, of either sign, in the preferred direction. We must also suppose that the differences in internal energy between the various *magnetic* complexions associated with a given strain are small in comparison with the energy of the strain. This is the more likely because we know that the electrical resistance and the length in the direction of alignment are almost unaffected by changes in magnetisation under these special conditions. This amounts to saying that the reversal of an atomic magnet involves little change in the internal energy of the crystal to which it belongs.

We differ from Akulov in supposing that an atomic magnet can pass from one strain-favoured direction to the other without necessarily dissipating the energy required *per atom* in changing the common direction of all the atomic magnets from the initial direction to an intervening position for which the internal energy is greater. Akulov, for example, sets the minimum hysteresis loss per cycle for reversal of magnetisation along a <100> direction at twice the energy difference for complete magnetisation along <110> and <100> directions. This loss, as Akulov points out, is absurdly too great. We avoid his difficulty by denying that in the reversal of magnetisation along a <100> direction the assembly of atomic magnets ever has any other common direction. We are thus able to go through cycles of magnetisation without working against the molecular field.

We cannot, however, go so far as Gerlach does in denying hysteresis losses altogether. The reversal method of changing magnetisation must still involve some dissipation of energy, because, for one thing, there must be resultant eddy currents in the adjacent metal. This loss will not depend upon the frequency of traversing the cycle if, as seems safe to assume, the reversals are as quick as other atomic energy jumps. We will therefore regard the low values of coercive force which Gerlach and others have attained as closely approaching the limit to which perfect atomic order would permit us to go. The low values of coercive force reached by Becker and Kirsten by stretching nickel are still far higher than this limit, and, indeed, the strains under even their extreme stresses must have been far from homogeneous on an atomic scale. The imperfections of real crystals may prevent our ever quite attaining the ideal case by purifying and annealing.

If these hypotheses are correct, the calculations of Frenkel and Dorfman, which depend for their validity upon magnetic saturation of each elementary region, are no longer valid.

The effect observed by Cioffi is distinctly more

* It may also be mentioned, though the facts are not pertinent to the present discussion, that the theory of the distorted dipole lattice, as the authors themselves state, predicts a magnetostriction of the wrong sign and amount, and that the similarity in the magnetic behaviour of cold-worked and annealed specimens under great tension is not surprising, in view of the fact that such tension is reported to have stretched the annealed specimen by so much as 10 per cent.

† This opinion has, of course, been held by others than Becker. My first explicit statement of the hypothesis was made in connexion with the magnetostriction of permalloy (*Phys. Rev.* [2], **28**, 158-166; 1926), where I said: " The more or less random stresses in ordinary metals would, in accordance with the views here expressed, do that for which this molecular field [of Weiss] was evoked, for they would in the case of all but favourably oriented atoms tend to maintain the established direction of magnetisation against small disturbances, and thus confer upon magnetisation that stability which the simple interaction of freely turning magnets cannot furnish ".

puzzling. It is suggested as possible that hydrogen dispersed throughout the lattice of iron crystals—not at lattice points—may act catalytically in the following way. Some of the iron atoms immediately adjacent to hydrogen atoms are thereby strained in a manner that favours increase in magnetisation by their reversal along the direction of the applied field. We know nothing of the manner in which hydrogen atoms conduct themselves in iron at room temperature, but it is at least possible that a single hydrogen atom may wander about sufficiently to strain in the favourable way a great many iron atoms in succession at each low value of the applied field. If this is the process involved, the hydrogen atoms must repeatedly lose their energy of thermal agitation, and therefore the iron must be cooled during the process and the energy must be supplied from outside by thermal conduction and by the magnetic field. If, as is the case, the reduction of area of the hysteresis loop is by more than 50 per cent, there will be a net cooling during each cycle, the hydrogenised iron being a refrigerating engine worked by cyclic magnetisation. Experiments with alternating magnetic fields should be competent to fix not only the amount of cooling integrated over many cycles, but also the time interval required for the complete promotion of magnetisation at each increment in magnetic field by the necessary random migration of hydrogen atoms.

This explanation would be much more fanciful if we had not recently learned from the experiments of Ellwood[9] that cooling may occur at certain stages in a hysteresis cycle, and that the heat developed in the whole cycle may be less if the cycle is traversed in many steps so that there are periods of ageing under the important applied fields. In Ellwood's case, carbon, not hydrogen, is known to have been present, and carbon is also known to enter the lattice of iron not at lattice points but by crowding into interatomic spaces. Its diffusion rate in iron at room temperature would be expected to be much less than that of hydrogen.

On these views, the possible ways in which magnetisation may change are two: (1) by reversals, without sensible magneto-resistance changes or magnetostriction, and with small but definite hysteresis losses probably closely conditioned by electrical conductivity; and (2) by rotations through less than 180°, with magneto-resistance and magnetostriction, with hysteresis losses of important amount largely controlled by mechanical strains inherent or induced by applied stresses, and possibly subject to catalytic acceleration.

L. W. MCKEEHAN.

Sloane Physics Laboratory,
Yale University, Oct. 15.

[1] R. Becker, *Zeits. f. Physik*, **62**, 253-269; 1930.
[2] R. Becker, M. Kirsten, *Zeits. f. Physik*, **64**, 660-681; 1930.
[3] J. Frenkel, J. Dorfman, NATURE, **126**, 274-275; Aug. 23, 1930.
[4] N. S. Akulov, *Zeits. f. Physik*, **64**, 559-562; 1930.
[5] W. Gerlach, *Zeits. f. Physik*, **64**, 502-506; 1930.
[6] P. P. Cioffi, NATURE, **126**, 200-201; Aug. 9, 1930.
[7] L. W. McKeehan, *Phys. Rev.* [2], **36**, 948-977; 1930.
[8] L. W. McKeehan, O. E. Buckley, *Phys. Rev.* [2], **33**, 636; 1929.
[9] W. B. Ellwood, *Phys. Rev.* [2], **36**, 1066-1082; 1930.

Unit of Atomic Weight.

THE discovery of the complexity of oxygen clearly necessitates a reconsideration of the scale on which we express the weights of atoms. Owing to the occurrence of O^{17} and O^{18}, now generally accepted, it follows that the mean atomic weight of this element, the present chemical standard, is slightly greater than the weight of its main constituent O^{16}. The most recent estimate of the divergence is 1·25 parts per 10,000.

This quantity, even apart from its smallness, is not of much significance to chemists, for the experience of the last twelve years has shown that complex elements do not vary appreciably in their isotopic constitution in natural processes or in ordinary chemical operations. Physics, on the other hand, is concerned with the weights of the individual atoms, and by the methods of the mass-spectrograph and the analysis of band spectra it is already possible to compare some of these with an accuracy of 1 in 10,000. Furthermore, the theoretical considerations of the structure of nuclei demand an accuracy of 1 in 100,000, which there is reasonable hope of attaining in the near future. The chemical unit is clearly unsuitable, and it seems highly desirable that a proper unit for expressing these quantities should be decided upon.

The proton, the neutral hydrogen atom, one-quarter of the neutral helium atom, one-sixteenth of the neutral oxygen atom 16, and several other possible units have been suggested. None of these is quite free from objection. It is desirable that this matter should be given attention, so that when a suitable opportunity occurs for a general discussion of the subject, each point of view may be afforded its proper weight in arriving at a conclusion.

F. W. ASTON.

Trinity College,
Cambridge, Dec. 4.

The Geological Importance of the Radioactivity of Potassium.

DR. A. HOLMES and Dr. R. W. Lawson in their paper on "The Radioactivity of Potassium and its Geological Significance" (*Phil. Mag.*, Dec. 1926, p. 1218) have estimated the heating effect of potassium by multiplying the average energy of the emitted β-ray by the number emitted per second. The energy can be obtained from the β-ray absorption coefficient, and the number emitted per second from the half value period. From the best data at the time available, they decided that the energy was $7{\cdot}3 \times 10^{-7}$ erg, and the half value period $1{\cdot}5 \times 10^{12}$ years; that is, about 225 β-rays are emitted per second per gram of potassium.

The recent work of W. Muhlhoff (*Annalen der Physik*, vol. 7, p. 205; and NATURE, Nov. 22, 1930, p. 823) leads, however, to a very much lower value. By the use of a Geiger and Müller sensitive particle counter he counts directly the number of β-rays emitted per gram of potassium; and obtains a value of 23 β-rays per second: not 225. This means that the heating effect will be reduced to one-tenth of its previously estimated value.

This result is important in connexion with a theory of the surface history of the earth advanced by me. For it increases the estimated period required for the thermal development of a 'revolution'; and in this manner contributes towards agreement with estimates of geological time based on the lead ratios of uranium and thorium as found in the rocks. J. JOLY.

Trinity College, Dublin,
Nov. 25.

Internal Conversion of Nuclear Energy.

WHEN a nucleus passes from an excited state into a state of lower energy, two different processes may occur: either a γ-quantum is emitted or one of the extra-nuclear electrons thrown out of the atom (with an energy equal to that of the γ-quantum minus the ionisation energy of the electronic level); in this case we speak of internal conversion of nuclear energy.

For a theoretical calculation of the probability of internal conversion, we have to know the interaction between the atomic electron and the excited nucleus. As is well known, the problem is different according as the distance is large or small compared with nuclear dimensions. On large distances the action of the excited nucleus can be described as the field of a Hertzian doublet. The part of the probability of ejection caused by the interaction in this region may be written as the product of the total number of γ-quanta emitted, times a factor K—depending only on the wave-length of the γ-ray—which we will call the coefficient of internal photo-effect.

In order to determine whether this effect, or the effect caused by the interaction in the nuclear region, is the more important for the ejection of atomic electrons, one has to evaluate the coefficient of internal photo-effect and compare it with the experimental data. The first calculations of this kind were carried out by Miss Swirles [1]; as, however, these calculations are based on non-relativistic wave mechanics, the results obtained cannot be expected to hold when the energy is large compared with mc^2, which is the case for most of the γ-rays investigated. It is necessary, therefore, to deduce a relativistic formula. Using Dirac's equation and assuming, for simplicity, that the energy of the γ-quantum is large compared with mc^2 ($5{\cdot}1 \times 10^5$ volt) I arrive at the following expression:

$$K = \frac{1}{Z} \cdot \frac{1}{\rho} \cdot \alpha^2 \cdot (2\alpha)^{2\sqrt{1-\alpha^2}} \cdot \frac{|\Gamma(\sqrt{1-\alpha^2} - i\alpha)|^2}{\Gamma(2\sqrt{1-\alpha^2}+1)} \cdot e^{-2\alpha \arccos \alpha}$$

where $\alpha = \frac{Ze^2}{hc}$ and ρ the ratio of the momentum of the ejected electron to mc. Putting $Z = 83$ (RaC) we find:

$$K = 0{\cdot}82 \times 10^{-3} \cdot \frac{1}{\rho}.$$

The ratio of the number of ejected electrons to the number of γ-quanta emitted for radium-C has been measured by Ellis and Aston.[2] These values are given in the second column of the accompanying table; the last column gives the theoretical values of internal photo-effect:

Energy of γ-ray in volts $\times 10^{-5}$.	Measured internal conversion $\times 10^4$.	Calculated photo-effect $\times 10^4$.
6·12	61	4·6
7·73	48	3·7
9·41	61	3·3
11·30	62	2·8
12·48	57	2·6
13·90	14	2·4
14·26	10^4 (?)	2·3
17·78	16	1·8
22·19	13	1·6

From this table we see that the number of ejected electrons is much larger than the number we could expect from internal photo-effect. This means that for the hard γ-rays of radium-C the ejection of atomic electrons is mainly due to the interaction in the nuclear region.

An attempt to estimate this effect was recently made by R. H. Fowler,[3] with the assumption of the Coulomb law of interaction between the atomic electron and an α-particle, moving in a potential box. The probability of ejection, calculated in this way, is too small to account for the discrepancy between the experimental values and the theoretical values of internal photo-effect. Fowler, also, uses non-relativistic wave mechanics. It may, however, easily be seen from general considerations that also in the present relativistic theory the effect always will be much smaller than the internal photo-effect. Clearly we are here outside the limits of applicability of relativistic wave mechanics. In these circumstances it is scarcely justified to lay too much stress on the agreement between Fowler's calculations and experiment for the β-ray line $14{\cdot}26 \times 10^5$ volt. The only thing independent of special ideas about the interaction is that one would always expect the effect to be about proportional to the probability density of the ejected electron in the nucleus ($r \to 0$). This is actually confirmed by the experiments about conversion in other than the K-levels. The electrons are ejected by hard γ-rays only from such levels as K_1, L_1, M_1, . . ., where the density at the origin does not vanish. For the ratios of the densities in the nucleus for a $2S$ and a $1S$ state we find (in the relativistic theory) 0·15 in good agreement with the experimental ratios of the coefficients of internal conversion in the L- and K-levels.

H. CASIMIR.

Institute for Theoretical Physics,
Copenhagen, Nov. 16.

[1] *Proc. Roy. Soc.*, A, **116**, p. 491; 1927; **121**, p. 447; 1928.
[2] *Proc. Roy. Soc.*, A, **129**, p. 180; 1930.
[3] *Proc. Roy. Soc.*, A, **129**, p. 1; 1930.

Electric Conduction in Metals.

THIS note has reference to the very interesting paper by Mr. R. H. Fowler in the Supplement to NATURE of Oct. 18 last on the conduction of electricity in metals. In this he refers to the difficulty in connexion with Drude's model in that the free electrons in the spaces should behave like a perfect gas, and so affect the specific heat relations As experience shows that this is not so, the inference is drawn that the dynamics is wrong and we must invent a new one. But another inference would seem more natural: that the conclusion that the electrons behave like a perfect gas is wrong and we must seek the reason why. I think this is not far to seek, and the error lies in supposing that the *same* electrons are continuously in the free space. This may be illustrated by taking the theory of emission as proposed recently by me in the *Philosophical Magazine* (**8**, 108; 1919). Shortly put—the nucleus decides what particular orbits of electrons round it are to fall in, the energy of fall goes to the nucleus, and the nucleus radiates according to the $nh\nu$ law. Conversely, the reverse process also takes place. When radiations fall on the atom it absorbs those of its special periods, and when it has absorbed the quota $h\nu$ it raises an electron to a corresponding outer orbit. This then falls in and its energy is radiated again by the nucleus. Amongst these operations, some will be due to free electrons falling in, and a similar set being set free. Consequently, the free electrons in the interatomic spaces will be continually passing in and out, and they never have time to take up the energy due to the temperature of the space. The time required for this must be considerable, measured in terms of the mean interval between collisions.

The theory explains, further, the remarkable fact that a single atom behaves as a smooth sphere—or, in other words, its internal system appears dynamically isolated. In the early days of the theory of the rigid atom, the hypothesis of a smooth sphere completely explained the difficulty. But an atom consisting of a nucleus and a number of electrons circulating round it carries with it difficulties as to the equal distribution of energies between the large number of degrees of freedom involved. This difficulty disappears on the present theory. An electron entering

the domain of an ionised atom dissipates its energy until it takes up some critical orbit. Then it falls to its normal place of lowest energy in the system. The energy goes to the nucleus and is promptly got rid of by radiation. *Or*, conversely, in a hot region, the temperature radiation of the space falls on the nucleus and those of the critical periods only are absorbed. The energy is then got rid of by the reversed process. In this way the mean internal energy of the atom remains the same always, and it behaves apparently as an isolated dynamical system. The atom itself would appear to have the structure of a perfect machine. W. M. HICKS.

Change in Electron Coupling in the Rare Gases.

HOUSTON (*Phys. Rev.*, **33**, 297 ; 1929) has worked out an approximate quantum mechanical theory of the relation of the triplet interval ratio to the singlet-triplet interval for two electron configurations in which one of the electrons is in an *s*-state ; he has also derived expressions for the *g*-values and for the intensities. Those formulæ show the variation with change of coupling.

Recently Laporte and Inglis (*Phys. Rev.*, **35**, **1337** ; 1930) have applied Houston's results to configurations like p^5s and d^9s by considering the invariance of the configurations p^5 and d^9 with changing coupling and taking the spin-orbit interaction and coupling factor with negative sign. The only spectrum in which the calculated *g*-values could be compared with experimental values was that of Ne I. In that spectrum Back (*Ann. der Phys.*, **76**, 329 ; 1925) has measured the *g*-values of the singlet and middle triplet level of the configuration $2p^53s$. The experimental data on the Zeeman effect of the rare gases which I have at my disposal, from my work on this subject in Prof. Zeeman's laboratory, enable me to give experimental *g*-values of the analogous levels of the configuration $3p^54s$ in A I and $4p^55s$ in Kr I. In the spectrum of Xe I only the *g*-value of the middle triplet level of the configuration $5p^56s$ could be measured. The following table gives the comparison of experimental and theoretical values.

Notation.		*g*-values.						
Paschen.	Russell-Saunders.		(*SL*) coupling.	Ne I.	A I.	Kr I.	Xe I.	(*JJ*) coupling.
s_2	$^1P_1$	obs.		1·034	1·10	1·26	..	
		calc.	1·000	1·036	1·101	1·257	1·281	1·333
s_4	$^3P_1$	obs.		1·464	1·40	1·24⁵	1·18	
		calc.	1·500	1·464	1·399	1·243	1·219	1·166

The agreement of the observed and calculated *g*-values is very satisfactory in the cases of Ne I, A I, and Kr I. The agreement is not so good in the case of Xe I, due probably to the fact that the first order perturbation calculations do not hold for very large values of the spin-orbit interaction.

A more detailed description of the measurements will be given elsewhere. C. J. BAKKER.

Laboratory " Physica ",
University, Amsterdam,
November 1930.

Surface Films.

READERS of Dr. Langmuir's stimulating and detailed review of my book, " The Physics and Chemistry of Surfaces " (NATURE, Nov. 8), may possibly suppose that there is an important difference of opinion on fundamental questions of the structure of surface films, from the criticism which he makes of one remark in the book. This I do not believe is the case ; the differences, if there are any, relate to points of detail only. Dr. Langmuir appears to think I am disputing the fact that the heads of the molecules anchor them to the water and so cause spreading from bulk material on the surface ; but this fundamental fact, which he himself established, is not doubted by any worker in this field, so far as I know, and has been confirmed *without exception* in many thousands of my own experiments. It is rather important that no impression of disagreement should be given on this matter ; the water-soluble or 'polar' group unquestionably anchors the molecules to the surface, and if the attraction of this group is weakened sufficiently, the film either becomes unstable or cannot be formed at all. This anchoring is equally important in all classes of films, condensed, expanded, and gaseous.

My suggestion on page 75, " that the heads tend to hold the molecules together, while the chains try to disrupt the film ", may be better for some explanation, since taken out of its context it is liable to be entirely misleading. It applies only to the 'liquid expanded' state of the films, and the disruption considered is a surface 'evaporation', or escape of the molecules laterally from coherent islands of monomolecular film, to form gaseous films, not a disruption by collapse of the film to form aggregates on the surface. The liquid expanded state is intermediate between the most coherent state, the condensed, and the least coherent state, the gaseous, in which there is so little lateral adhesion between the molecules that they move about independently in the surface like a two-dimensional gas. In all these states, the molecules are anchored to the water by their heads ; in the condensed, they are held together in coherent islands by the lateral adhesion of both heads and chains ; in the gaseous, the lateral adhesion has been practically completely overcome. In the expanded, my suggestion is that the thermal agitation has reached an amount sufficient to overcome the lateral adhesion between the chains, but that there still remains enough adhesion between the heads to prevent separation of the molecules completely. This would mean that the chains are whipping about violently, the restraints on their thermal agitation having broken down more or less completely ; the heads of the molecules near the water are, however, exercising a restraining force, keeping the molecules from flying off laterally along the surface.

This suggestion is not more than a speculation, yet I believe it is the best and indeed the only tenable one of the many speculations which have yet been made as to the structure of the liquid expanded films. The principal facts to be explained are these : the films are coherent, with but a small surface vapour pressure ; their area is two or three times the minimum area to which the molecules can pack in the surface ; they are not formed unless there is a good deal of residual affinity in the heads of the molecules, series of compounds in which the residual affinity in the heads is small passing straight from the condensed to the gaseous (or sometimes 'vapour expanded') films ; they are formed from condensed films (provided there is sufficient residual affinity in the heads) by rise of temperature, a higher temperature being required the longer the chain in the molecule, which indicates that all, or some part of, the lateral adhesion between chains has disappeared in the liquid expanded films.

My principal doubt in regard to this explanation is as to the propriety of separating in this clear-cut way between the adhesions due to the chains and those due to the heads. It seems scarcely likely that the adhesions can break down completely throughout

the length of the chains and still remain intact at the heads. Also, there is some difficulty in picturing the mode in which the heads can hold the molecules together when these are separated to two or three times their normal (areal, not lineal) spacing. My suggestion, which was made in 1928, is really the reverse of an earlier suggestion of Dr. Langmuir's, that in these liquid expanded films the heads are trying to be free as in the gaseous films, while the chains are restraining them. This does not fit the experimental facts as now known.

Let me repeat that this doubtful matter does not in the least affect the fundamental points of the theory of surface films, which were so well established by Dr. Langmuir that years of further research have only consolidated his position on all the most important questions.

Dr. Langmuir suggests that too much is made of the 'tilt' of the molecules in the films. I must plead not guilty to much definite theorising in this direction, for we owe nearly all that has been done to Dr. Rideal and his school in Cambridge. But I am sure that if we could find out the tilt of the molecules, we should know much more about the detailed structure of these films than we actually do; and therefore, although I do not believe the recent theory of Lyons and Rideal, that the chains interlock at definite angles of tilt, is correct or even probable, I cannot but applaud them for having taken some cognisance of the possibility of definite angles of tilt determined by the form of the molecules. Dr. Langmuir thinks that the molecules are nearly as free in the films as in liquids, except for their being anchored to the water by their heads. This cannot, I think, be true of all states of the films; it may quite likely be nearly true of the liquid expanded films, but surely in the condensed films, both solid and liquid, there is not room enough for as much free motion of the molecules as occurs in liquids. In one kind of condensed film, where the area is greater than that of closely packed chains, I think that the packing of the heads and perhaps a small length of the chains close to the heads decides the *area* of the film, and the rest of the chains, being flexible, pack in as best they can into the space so determined above the heads; Rideal and Lyons seem to think that the heads determine the *tilt* of the molecules and that this tilt determines the area. These differences of opinion, we may hope, will be decided in course of time.

N. K. ADAM.

University College,
Gower Street, London, W.C.1,
Nov. 18.

Embryology and Evolution.

FOUR of Prof. MacBride's statements, in NATURE of Dec. 6, call for comment. "... no one has ever seen 'genes' in a chromosome." Genes cannot generally be seen, because in most organisms they are too small. In *Drosophila* more than 100, probably more than 1000, are contained in a chromosome about 1 μ in length. They are therefore invisible for exactly the same reasons as molecules. But the evidence for their existence is, to many minds, as cogent. Where the chromosomes are larger, as in monocotyledons, competent microscopists—for example, Belling, in NATURE of Jan. 11, 1930—claim to have seen genes. In a case where I (among others) postulated the absence of a gene in certain races of *Matthiola*, my friend Mr. Philp has since detected the absence of a trabant, which is normally present, from a certain chromosome. I shall be glad to show this visible gene to Prof. MacBride.

"... if Prof. Gates were a zoologist instead of being a botanist, he would know that the assumption that 'genes' have anything to do with evolution leads to results ... that can only be described as farcical", I should like to direct Prof. MacBride's attention to the droll fact that in a good many interspecific crosses various characters behave in a Mendelian manner, that is, are due to genes. This is so, for example, with the coat colour of *Cavia rufescens*, which, on crossing with the domestic guinea-pig, behaves as a recessive to the normal coat colour, but a dominant to the black. Hence there has been a change in a gene concerned in its production during the course of evolution. Scores of similar cases could be cited.

"All known chemical actions are inhibited by the accumulation of the products of the reaction. An 'autocatalytic' reaction, in which the products of the reaction accelerated it, must surely be a vitalistic one!" Autocatalytic reactions are common both in ordinary physical chemistry and in that of enzymes. Thus the acid produced by the hydrolysis of an ester may accelerate its further hydrolysis. As an example of an enzyme action, which for quite simple physico-chemical reasons proceeds with increasing velocity up to 75 per cent completion, I would refer Prof. MacBride to Table 7 of Bamann and Schmeller's[1] paper on liver lipase.

In view of such facts, Prof. MacBride's statement that "The term 'autocatalysis' is a piece of bluff invented by the late Prof. Loeb to cover up a hole in the argument in his book" would seem to be a wholly unfounded attack on a great man who can no longer defend himself. If Prof. MacBride would acquaint himself with the facts of chemistry and genetics, he might be somewhat more careful in his criticism of those who attempt to analyse the phenomena of life. He might also cease to ask the question propounded by him in NATURE of Oct. 25, "whether the organs of the adult exist in the egg preformed in miniature and development consists essentially in an unfolding and growing bigger of these rudiments, or whether the egg is at first undifferentiated material which from unknown causes afterwards becomes more and more complicated and development is consequently an 'epigenesis'". The formation of bone in the embryo chick was shown by Fell and Robison[2] to be due to the action of the enzyme phosphatase, which is neither a miniature bone nor an unknown cause. But so long as he does not take cognisance of recent developments in science, Prof. MacBride will no doubt remain a convinced vitalist.

J. B. S. HALDANE.

Biochemical Laboratory,
Cambridge University, Dec. 8.

[1] *Zeit. Physiol. Chem.*, **188**, p. 167.
[2] *Biochem. Jour.*, **23**, p. 766.

Ravens Flying Upside Down.

BIRDS frequently perform strange antics in the air, both during courtship and at other times, and the air acrobatics of the raven have long been known. Thus Morris describes him as "performing various circling evolutions and frolicsome somersets in view of his mate". Yarrell, a better observer, says that in courtship the raven "turns over sideways on his back as he flies, shooting in that position in front of his mate". More recently, in 1917 if my memory serves me, the trick of flying upside down was referred to in a well-informed article on ravens which appeared in the *Times*.

Watching birds has long been a hobby of mine, and I once had the good fortune to see a raven flying on his back. The sight was extraordinary and unforgettable, but at the time I did not realise that I had witnessed

something very unusual in the behaviour of the raven and unfortunately I made no note. Now, however, after the lapse of many years, it has been suggested to me that the facts are worth recording.

The observation was made in July 1917, when I was staying in Patterdale. One morning, between nine and ten o'clock, I was standing in front of Patterdale Hotel watching a pair of ravens flying across the Dale from Place Fell towards the wooded heights above Patterdale Hall. They passed by me rather low down and within about 200 yards. It was a clear, bright morning, and the sun being behind me the observing conditions were favourable. I was using an excellent pair of field-glasses, magnifying eight times, and with a field of about 5°. The two birds were flying close alongside each other, as is the habit of ravens. As they were passing by, the one nearer to me suddenly, and without any warning action, rolled over sideways and after falling in a confused fashion ended on his back, some five or six feet below his mate. In this position, and without losing horizontal speed, he continued flying; or to describe more precisely what I saw, he remained on his back, flapped his wings, and travelled along in what appeared to be level flight. He kept pace with his mate, who continued stolidly on her way entirely unconcerned by the antics of her partner down below. After flying upside down for a considerable distance, the raven rolled over again and got himself right side up; not without a fluster of wings and loss of height. By this time the birds were a good deal farther off and observation had become more difficult, but before they finally passed out of sight I noticed that they were once more flying side by side, as a pair of self-respecting ravens should do.

It was not easy to estimate the distance the raven flew upside down. Anyone who has had to do with the range-finding of aircraft, as I had to do during the War, will appreciate the difficulty of estimating, even roughly, the distance travelled by a flying bird. However, doing the best I could, I judged the distance the raven flew while he was upside down to be not less than 100 yards and very possibly a good deal more. That, at all events, was the judgment of the observer at the time and on the spot.

Some years later I began to wonder how the wings of a bird would work, if at all, when the bird was on its back; and whether, in the absence of aid from the flapping wings, the kinetic energy acquired in tumbling downwards would have sufficed to carry the raven on a level course over the observed distance. But such speculations as these do not affect what I saw, and the sight has remained vividly present in my mind from that day to this.

SYDNEY EVERSHED.
40 Woodville Gardens, London, W.5,
Nov. 9.

Masking of Spike-disease Symptoms in *Santalum album* (Linn.).

DURING the course of disease transmission studies, it was found that certain stocks for long periods did not exhibit the characteristic symptoms of the disease, and were therefore believed to represent disease-resistant varieties. The leaf tissue from such operated and disease-resistant varieties was found non-infective as shown by transmission experiments conducted with the leaf on susceptible stocks. Two such plants on being accidentally injured—in one case by a borer, and by wind in the other, both involving the removal of much foliage—exhibited the characteristic symptoms during the course of 15 days after the accident, with sprouting of the dormant buds. This suggested the possibility of accelerating the manifestation of disease symptoms by defoliation and by light pruning, which has met with great success. Foliage tends to inhibit the external manifestation of the disease symptoms. In one instance the infected stock remained apparently healthy for 417 days and more than doubled its girth and size during this period; but on light pruning and defoliation the stock exhibited the symptoms during the course of 16 days, with bursting of the dormant buds. A study of the physiological changes in the composition and reaction of the cell sap induced by defoliation should reveal the true cause of this remarkable phenomenon.

In diseased forest areas, therefore, external appearance of sandal is not the true criterion of its freedom from infection, which, if dormant, manifests itself on pruning the plant. This curious masking of symptoms in the case of sandal appears to be influenced by intense sunshine, and temperature. During this masked period the virus appears to be localised in certain tissues (phloem) of the plant, where it multiplies and exists in a highly virulent form.

M. SREENIVASAYA.
Department of Biochemistry,
Indian Institute of Science,
Bangalore, Nov. 4.

The Designation of Women Biologists.

MANY years ago, Dr. Eigenmann, of the University of Indiana, finding certain small fresh-water fishes of South America very perplexing, decided to turn them over to one of his most capable students, Miss Marion Durbin. In due course of time Miss Durbin published a new genus and twelve new species of Tetragonopterid Characins, small fishes of a type which has since become very popular in parlour aquaria. Miss Durbin married Dr. Max Ellis, and papers on South American fishes, with new species, were afterwards written by each. As the species are usually cited, they are credited to Ellis, and the reader may or may not know that if they belong to a certain family they are of Max Ellis, if of another they were described by the former Miss Durbin. The first initial being the same in both cases, it is necessary to cite two initials to indicate which is which. In 1921 some new South American birds were published by G. K. Cherrie and Mrs. E. M. B. Reichenberger. There has just appeared an admirable revision of the birds of Matto Grosso, by Mrs. Naumburg. But Mrs. Naumburg is identical with the former Mrs. Reichenberger.

These examples suggest that, in view of the constantly increasing number of taxonomic papers by women, and the confusion which must result from the customary method of designating them, it would be an advantage to all concerned if, for the purposes of publication and citation, the maiden name were used without any change. It would always be possible to add the married name, as "By Mary Smith (Mrs. Wm. Jones)". Should this reform be supported by councils of societies and editors of journals, it is probable that little or no opposition would be met from the authors themselves. There is at least one well-known case of a woman author of taxonomic papers retaining her maiden name, though married.

T. D. A. COCKERELL.
University of Colorado,
Boulder, Nov. 12.

Transmission of Infantile Kala-azar.

WITH reference to Drs. Adler and Theodor's note entitled "Infection of *Phlebotomus perniciosus* Newstead with *Leishmania infantum*", published in NATURE of Sept. 20, I would like to add that the insect concerned has not as yet been recognised as a distinct species, but only as a variety of *Phlebotomus major*

Ann. Mr. E. Brunetti [1] (1912) remarks in this connexion as follows: *P. major* var. *perniciosus* Newstead, "A form described by Newstead as a distinct species from Malta is, according to Dr. Annandale, only a variety of *P. major*, an opinion in which I am inclined to concur, there being no difference in either the venation or the male genitalia". Sinton [2] (1928) supports the same view.

S. MUKERJI
(Entomologist, Ancillary Inquiry into the Transmission of Kala-azar).

Kala-azar Research Laboratory,
School of Tropical Medicine and Hygiene,
Calcutta, Nov. 5.

[1] Brunetti, E., "The Fauna of British India" (Diptera, Nematocera"), p. 211; 1912.
[2] Sinton, J. A., *Ind. Jour. Med. Res.*, **16**, 2, pp. 303-305; 1928.

THE Editor of NATURE has kindly permitted me to see Dr. Mukerji's letter, and I am glad to have the opportunity of replying to it.

Several investigators have recognised that *Phlebotomus major* and *P. perniciosus* are closely related. França and Parrot (1921) named the latter sandfly *P. major* var. *perniciosus*. It is, however, certain in the light of recent investigations that *P. major* and *P. perniciosus* are distinct species. The males can easily be distinguished. They have a similar pattern of external genitalia common to all the males of the *major* group, but they show constant differences in important details.[1] The females can also be distinguished, though not so readily as the males. This problem is discussed in several papers which will be published shortly.

It cannot be emphasised too strongly that it is important to distinguish between closely related species of *Phlebotomus*, for these often show striking differences in their bionomics and distribution, and they may also differ in their capacity for transmitting disease. S. ADLER.

Nov. 29.

[1] Adler, S., and Theodor, O., The Distribution of Sandflies and Leishmaniasis in Palestine, Syria, and Mesopotamia. *Ann. Trop. Med. and Parasitol.*, vol. 23, No. 2, pp. 269-306; 1929.

Leaf-Curl in Cotton.

IN an interesting letter (NATURE, May 3, 1930, p. 672) Mr. Kirkpatrick states that in the Gezira area (Sudan) an undetermined species of Aleurodidæ causes leaf-crinkle. In the Punjab (N.W. India) *Bemisia gossypiperda*, Misra and Lamba (Aleurodidæ), has been under observation during the last two years. This insect is present in enormous numbers but is not known to cause any deformation of the attacked leaves. Even in cages under conditions of a pure infestation of *B. gossypiperda* leaves literally covered on the under side with all the stages of the pest—eggs, nymphs, pupæ, and adults—remain quite flat and normal, and do not show curling, wrinkling, or crinkling. On the other hand, *Empoasca devastans* (Jassidæ) definitely causes leaf-crinkle.

From the sentence quoted by Mr. Kirkpatrick from "Cotton in Africa" (NATURE, Feb. 22, 1930, pp. 291-92), and from his own statement that "leaf-curl of cotton . . . is transmitted mainly, if not entirely, by . . . Aleurodidæ . . .", one is led to think that the disease is due to a causal agent which is carried either by a jassid or a white-fly. Has this been fully established?

In the Punjab we have had under observation several species of white-flies on several different hosts—for example, citrus, castor, sugar-cane, cotton, etc.—but none of these white-flies causes any malformation of the attacked leaves. M. AFZAL HUSAIN.

Entomological Section,
Agricultural Research Institute,
Lyallpur, Punjab.

Living Ostracods in the Rectum of a Frog.

QUITE recently I received a communication from Mr. J. Omer-Cooper in the course of which he said: "When examining the contents of a frog's rectum yesterday in the course of our lab. work I noticed several living Ostracods. The frog had been kept for some time in a small aquarium which contains a good many ostracods. I have pickled up some of the contents of the rectum and also some of the ostracods from the aquarium. . . . The frog was chloroformed, well washed under the tap and dissected in normal salt solution. There is no chance that accidental contamination of the preparation can have taken place."

I examined both lots of ostracods and find that the two agree. Actually there was only one species present and that was *Pionocypris vidua* O. F. Müller, a very common ostracod. The observation is of interest as it gives a means of distribution of this ostracod, and the distribution of freshwater Entomostraca generally is a problem that requires a considerable amount of investigation.

There is, however, another aspect to the problem. The species in question is easily cultivated and reproduces parthenogenetically. Pure cultures can be obtained. If these are capable of passing through the intestines of various animals they may furnish a method of investigating certain changes that are going on there, both pathological and otherwise.

A. G. LOWNDES.

Marlborough College,
Wilts.

Prof. H. B. Dixon.

THE news of the sudden and unexpected passing of Prof. Harold B. Dixon has just reached me, bringing with it the shock of personal loss. As one of the oldest of his Manchester students, space may perhaps be granted me for a few words of personal tribute.

I saw Prof. Dixon last when I was in Manchester in 1925. I called at his house rather late in the evening and found him busily engaged with a tableful of papers, working out calculations in connexion with his latest researches on gaseous combustion. We talked about his work and exchanged news of his old students until I missed the last tram into Manchester.

It was not until quite recently that I wrote to tell him of my doings since that meeting, and by return mail I received a charming letter from him, enclosing a page from his diary, closely packed with a week's engagements, while gently chaffing me on my partial 'retirement' in Bangalore. It was the last example of his method of the *oratio obliqua* so well known to his students. Like all of these, I owe him unmeasured gratitude for shrewd and wise advice, and effective help, at critical junctures. His careful watchfulness over our welfare was not always realised until revealed by later happenings.

Prof. Dixon was a splendid example of the scientific research spirit at its best, combined with an active and broad interest in human affairs. It was a privilege to know him well and to come under the stimulus of his inspiration. GILBERT J. FOWLER.

Central Hotel, Bangalore, South India,
Oct. 27.

The Machinery of the Earth.*

By Prof. J. W. GREGORY, F.R.S.

A DEFINITION of the word "machine" given in "The New English Dictionary" is "a combination of parts moving mechanically, as contrasted with a being having life, consciousness and will". According to that definition, the whole earth may be regarded as a machine, as it consists of various parts with differential movements, and it is moving in mechanical obedience to the forces of the universe and without any impulse or free will of its own. The study of the primary machinery of the earth involves consideration of its construction and of those movements of its parts which control its main function—the preparation and maintenance of its surface as the home of man.

THE STRUCTURE OF THE EARTH.

The geological method—the interpretation of the direct contemporary evidence of the rocks—has the drawback that it can only be applied directly to a thin layer, which is about one five-hundredth of the radius of the earth; and this restriction is the more regrettable as the material of the interior is different from that of the surface crust. The extent of this difference was revealed by Sir Isaac Newton, who calculated that the specific gravity of the earth is between 5 and 6. The figure generally accepted is 5·53.

Ordinary rocks vary in specific gravity between the 1·8 of clay, and 2·2 of sandstone, and 3·0 of basalt. The average cannot be more than about 2·5. For the whole rocky crust or lithosphere, which includes a great thickness of the deeper basic igneous rocks, the average specific gravity is taken by Tyrrell as 2·7. Hence the earth as a whole is composed of material more than twice as heavy as that of the crust. The internal mass is therefore appropriately named the barysphere, and a large amount of it must have a specific gravity four times as high as that of the rocks of the upper crust. It has been suggested that the matter in the interior owes its density to compression; but that view has been abandoned, and the high specific gravity of the interior is attributed to the segregation there of a large proportion of metals.

The high specific gravity of the earth can be accounted for by a metallic core with the specific gravity of about 8 to 10, or, perhaps in part, as much as 12. The material is probably mainly metallic iron alloyed with nickel, and containing smaller proportions of other metals and various silicates.

The composition of the barysphere is revealed by several lines of evidence. We may expect the earth to consist of the same materials as other heavenly bodies; and the most positive information as to the extra-terrestrial material is given by samples which fall upon the earth from outer space. They are known as meteorites and are most familiar to us as shooting stars. Their numbers are enormous. Any quick-sighted observer on a dark cloudless night can see about seven in the hour. Hence from 10 to 20 millions enter the earth's atmosphere every day. The meteorites are shattered into fragments, which fall in lumps or dust upon the surface. They are divided into two main classes. The iron meteorites or siderites consist of metallic iron with from 3 to 41 per cent and usually from 7 to 15 per cent of nickel and small proportions of other metals and some silicates. The second class are the aerolites or stony meteorites, which consist mainly of silicates and of mineral species, especially olivine and enstatite, common in the basic rocks of the earth's crust. A small intermediate group, the stony-iron meteorites or siderolites, consists of nickel-iron and silicates.

The proportion of the iron to the stony meteorites according to Sir Lazarus Fletcher's list of the meteorites in the British Museum in 1904 was 13·7 to 1. Dr. Prior's British Museum Catalogue of Meteorites (1923) includes all those known up to 1922 and has rendered practicable a more complete estimate. According to the records in that catalogue nickel-iron is twenty-one times more abundant in meteorites than stony material. Hence, if the earth represents a fair average of the material of the universe as revealed by meteorites, its metallic barysphere would have twenty-one times the bulk of the stony crust, which would be about 140 miles thick.

The relative thinness of the stony crust is confirmed by radioactivity. The earth's radioactive power is surprisingly weak. As determined by Lord Rayleigh, it can be accounted for if all the radioactive constituents are confined to a depth of about 45 miles. The material below that shell is practically non-radioactive. The iron meteorites are also non-radioactive. This evidence indicates that the earth's core is composed of nickel-iron.

This conclusion was originally advanced by J. Milne from the study of earthquakes. He found that earthquake waves which in their course go deeper than 30 miles undergo marked acceleration, owing to their entry into a highly elastic material which Milne called 'geïte', as it is the rock that forms the bulk of the earth; and he concluded that it consists mainly of nickel-iron. Subsequent research has confirmed this conclusion. The earth consists of an outer stony shell—the earth's crust or lithosphere—which is separated by a fairly sharp surface from the underlying barysphere. This inner mass, being denser, more elastic, and non-radioactive, is probably a mass of nickel-iron, like the iron meteorites. That the core of this mass is different in constitution from the rest was shown, also from earthquake evidence, by R. D. Oldham. He found that earthquake waves of distortion do not pass through the central region of the earth. Within the elastic barysphere is a centrosphere, which transmits waves of compression but not waves of distortion. It is therefore either a liquid or a gas.

An earthquake sends out waves of three kinds from its centre of origin. Two of the sets of waves are small vibrations or tremors that go through the

* From the seventeenth Thomas Hawksley Lecture of the Institution of Mechanical Engineers, delivered on Nov. 7.

earth; the third set are large waves that travel along the surface and may cause widespread devastation. All three kinds of wave are recorded on seismographs at a suitable distance.

The simple earthquake seismogram includes records of the three kinds of waves; it begins with small jerks made by the first tremors, which are waves of compression. They are known as the *P*-waves, *P* standing for primary, as they arrive first; but the late Prof. Turner suggested the name of push-waves as they are pressure waves. The second set are the *S*-waves or secondary waves, which are due to vibrations at right-angles to the path of the earthquake. They are waves of distortion. Prof. Turner called them the shake-waves. They are followed by the large waves or *L*-waves.

The first push- and shake-waves travel at the speed with which such waves travel through granite; hence they must have passed through a layer of the earth's crust composed of a rock like granite.

Farther from the centre the seismogram is more complex, as two sets of push-waves and two of shake-waves may arrive before the large waves. Still farther away there may be three sets of push-waves and three of shake-waves. The P_g or shallow push-waves have a velocity of $3\frac{1}{4}$ miles per second, which is that of such waves through granite. The second set of push-waves (*PP* or P_x waves) have a velocity of 4 miles per second, which is that of such waves in diorite; the third set of push-waves (P_n) have the velocity of $4\frac{3}{4}$ miles per second, which is that in such a highly basic rock as dunite.

Accordingly it appears that below the surface is a layer of rock like granite; beneath it occurs diorite, as suggested by Prof. Holmes; and lower still is a more basic rock, which transmits the push-waves at $4\frac{3}{4}$ miles per second.

Farther from the origin of the earthquake four out of these six sets of waves are not recognised and only the P_n and S_n waves and the main waves leave their record on the seismogram.

The P_n and S_n waves both traverse the geïte until they reach the depth of 1800 miles. A wave going to that depth, emerges at the surface at a distance of 103° from its origin; between that distance and 144°, the push- and shake-waves are not recorded. So an earthquake under the north pole would be felt by its push- and shake-waves so far as 13° S. of the equator, in say southern Peru; farther south there would be no record of them before reaching the latitude of Cape Horn; but farther south again the push-waves would disturb the surface so far as the south pole. The shake-waves, however, would not be felt anywhere south of Peru.

This suppression of the shake-waves around the antipodes to the place of origin of an earthquake was first recognised and explained by R. D. Oldham. He pointed out that as only the waves of compression reach the antipodes, the earth's central core must consist of material which transmits waves of compression but not waves of distortion. It must therefore be liquid or gaseous. That it is liquid is shown by the yielding of the earth to tidal strain, which indicates a less rigid earth than earthquake observations; and Dr. H. Jeffreys has shown that the contradiction between this evidence disappears if a liquid centrosphere occupies half the diameter of the earth.

According to Oldham and Knott, the liquid core is a fifth of the radius or $\frac{1}{125}$th of the mass of the earth; but according to Dr. H. Jeffreys' estimate it is half the radius, or an eighth of the mass of the earth. This huge centrosphere is doubtless a liquid mass of nickel-iron, which, owing to compression, has a specific gravity of 12.

Such, then, is the general structure of the earth-machine; it has a fluid centre, a thick metallic shell, the barysphere, and an outer rocky crust, the lithosphere.

As the earth is approximately spherical, we may regard it as a huge projectile, travelling at an enormous velocity through space, and consisting of an iron shell which, like those of modern artillery, is hardened with an alloy of nickel.

Origin and History of the Earth.

The separation of the barysphere and lithosphere is the natural result of their difference in specific gravity. The lithosphere consists of light silicates and earthy materials which floated to the surface out of the heavy metallic mass, as the earthy impurities in iron-ore float to the top as slag when the ore is smelted in a furnace. The rocky crust may therefore be regarded as a slag which has exuded from the metallic mass below.

Laplace's long accepted nebular theory of the origin of the solar system is now generally discredited; and the earth is regarded as either a mass torn out of the sun by the attraction of a passing star, or as due to the aggregation of a swarm of meteorites, and mainly of those which, having a planetary orbit, are regarded as infinitesimally small planets and are known as planetismals.

The meteoritic theory of Lockyer and the planetismal theory of Chamberlin and Moulton are both out of favour in Great Britain; but they have to the geologist the advantage that they do not start the earth as a fragment of a body with, according to C. E. St. John, the temperature of 29,000,000° C. For the oldest and most deep-seated of the known rocks in the earth's crust show no evidence of transcendent temperatures.

Either the earth never experienced the supreme temperatures of the sun or hotter stars, measured by millions of degrees, or it had cooled down to about 5000° F. before the formation of the oldest known part of the crust.

The earth clearly passed through a stage in which it was so hot that it was plastic and behaved as a fluid body. One relic of this early stage is the high temperature of the earth's interior, as known from the uncomfortable heat of deep mines and the boiling water of deep-seated springs. The standard rise of temperature underground in Europe is 1° F. for every 53 or 58 feet of descent.

If that rate continued, the temperature 5 miles deep would be above 500° F. and at the earth's centre, 3950 miles deep, would be nearly 400,000° F. There is no geological evidence for such a tem-

perature within the earth. None of its minerals imply temperatures higher than the 2500° F. of sillimanite, or the 3100° F. of cristobalite, or the 3450° F. of some species of olivine. There is no geological evidence that the central hot mass or thermosphere has a temperature higher than a few thousand degrees. The internal heat was not too high to prevent the formation of a solid non-conducting crust, which soon became so thick as to prevent the thermosphere having any material influence on climate. The oldest interpretable fossils indicate that at the beginning of geological time the climate of the earth was about as warm as in modern times. Evidence of this surprising fact is given by the existence at about the time of the oldest fossiliferous rocks of glaciers in the Yangtze-kiang Valley, and of glaciers that nearly reached the tropics in South Australia. Those glaciers do not imply that all the earth had then a colder climate; but they do prove that the conditions were not tropical over the whole of the earth. Judging from the marine organisms nearest in date to these early glacial deposits, the mean climate of the earth was similar to that of to-day.

Climate has undergone marked local variations. Sometimes it was more uniform over the earth and at others the extremes were greater, after mountain uplifts had increased the local differences.

Even allowing for such changes and for those due to different distributions of land and sea, the meteorological agents have been remarkably uniform. In rocks of all ages the imprints of the raindrops are of about the same size. The sand grains spread over the deserts or heaped in sand dunes, and the ripples on 'the sands of time' have been always approximately equal; and the particles of volcanic dust and tuff also show that the ejecta of ancient and modern volcanoes have been scattered by volcanic explosions and winds of similar power.

This climatic uniformity since the Cambrian period indicates that the earth's crust had by then acquired approximately its present thickness and strength. Before that date it must have been thinner and weaker, as is proved by the universally tilted condition of the primeval (Pampalozoic) rocks. The sedimentary rocks of the crust were deposited in horizontal layers; most of them have been tilted. The younger rocks generally have a slight dip except near fold-mountain chains, which are due to the crust having been squeezed into a smaller space, and having accommodated itself to this compression by folding. In modern rocks violent lateral compression is limited to relatively narrow belts along the younger fold-mountain chains.

As the older rocks of the crust are steeply tilted in all parts of the earth, the pressure that disturbed them was then universal. The crust was undergoing contraction to an extent which threw all that is known of it into folds, for as the crust sank over the diminishing internal mass the whole of it was packed into a narrower space and was thereby thickened and strengthened.

The change from the thin, universally crumpled crust of the older primeval time to the thicker, stronger crust which yields to compression by package along narrow bands has led to a fundamental difference in geographical conditions. Land and water were re-distributed and this change had a great effect on local climates.

When the crust was weak, its buckling would have produced many shallow basins and domes, so that water was distributed in land-locked seas, scattered widely over the surface. The total sea surface was apparently much less than at present, for the commonest rocks of the latter part of the primeval era are reddish sandstones and layers of red shale, with wind-rolled sand grains and pebbles polished and faceted by wind-blown dust.

The powerful effects of the wind and the prevalent desert conditions may have been due in part to the absence of turf, which binds the sand and prevents its grains being constantly rolled forward by the wind. The lack of land vegetation suggests that the environment was unfavourable for it. The extensive limestones in the primeval seas indicate that seaweeds were luxuriant. The failure of plants to grow well on land suggests that the conditions did not suit them. The absence of land vegetation until Silurian and Devonian times may have been due to climate. The prevalence of deserts in the upper Pampalozoic is evidence of a dry atmosphere, which would have been the natural result of a greater proportion of land to sea than in later geological epochs.

The growth of the seas involves an increase in the amount of water on the earth's surface. The possibility of this increase was discredited when the authoritative estimates of the age of the earth varied between ten million and a hundred million years. Annual additions to the surface water that would be negligible in a few million years become important when they accumulate for thousands of millions of years.

At one time it was held that all the water on the earth's surface is meteoric and has fallen as rain. But the evidence is convincing that much of the water of hot springs and deep mines and that given off by igneous rocks and volcanoes is of deep-seated origin. It is plutonic water which has worked its way to the surface. The amount discharged was probably greatest in early times when the crust was thinner and more often fractured. The transfer of deep-seated water from the interior to the surface during geological time must have added largely to the volume of the seas. According to Prof. Schuchert the earth's surface water may have increased by 25 per cent since the beginning of the Cambrian period. Though data for a quantitative determination are inadequate, the evidence is in favour of the seas of the earlier days having been shallower and less extensive.

Hence, although the earth's crust had early become sufficiently thick to cut off the surface from any material contribution from the internal heat, yet the shrinkage of the interior so frequently fractured the crust that plutonic water rising through the fissures has continually widened the seas and thus helped in the better nourishment of the land.

THE EARTH IN MOTION.

The earth is not only a complex structure built up of several distinct parts, but also it is in motion at a terrific speed. It is charging through space, with the rest of the solar system, at the rate of 750 miles a minute; it travels along its orbit around the sun at more than 1000 miles a minute; and its rotation around its axis gives any place on the equator an additional movement of more than 1000 miles an hour. The fact that the earth holds together in spite of such movements shows that it is strongly constructed; but it is sufficiently plastic, owing to its hot interior, to be automatically moulded into a spheroid, or more correctly, into a geoid. It is approximately an oblate spheroid owing to the moulding force of its rotation.

The rotation has not been uniform. Owing to tidal friction it is slowly losing speed and the day lengthening. According to Sir George Darwin and Dr. H. Jeffreys, the earth's day was at one time only five hours long. Changes in the shape have also affected its rate. For example, the polar regions have been raised and lowered to an extent that would have affected the earth's ellipticity as shown by the widespread occurrence of raised beaches in both the polar regions. These beaches are so regular and horizontal that they have been attributed to the so-called 'eustatic' movements or world-wide variations of sea-level. But that view is improbable, as the raised beaches, which are conspicuous in Scotland, occur at a lower level or are absent from most of England.

A change in the earth's rate of rotation would produce circumpolar beaches, for its slackening would lower the sea in the tropics and raise it in the polar regions. The distribution of the raised beaches is, however, probably due to the alternate subsidence and upheaval of the polar areas; and if both of them had sagged simultaneously the earth's ellipticity would have been increased and therefore also its rate of rotation.

The earth revolves like a badly made and badly mounted fly-wheel, and its wobbling causes some shifting in the position of the poles, as proved by the variation of latitude. The movement of the poles that has been actually observed is small, and has been attributed to meteorological factors, which Dr. Jeffreys has shown to be insufficient. The deformation of the earth by crustal changes is the more probable cause. Any extensive migration of the poles has been declared impossible, since a body with so heavy a load on its circumference as the earth's equatorial bulge could undergo but minor oscillation of its axis. That the wandering of the poles has been within narrow limits is consistent with the geological evidence; for the distribution of animal life has been along zones that were in general parallel to the present climatic zones.

The changes in shape of the earth have, however, had an important influence in other respects. The earth cannot be deformed beyond a limited amount or it would become unstable and ultimately fly to pieces. But with the wonderful automatic adjustments of the earth, as soon as deformation renders the crust unstable, stability is restored by movements by which the approximately spheroidal form is recovered. The convulsions during this process lead to changes in the crust that are indispensable for its primary service as the home of man. The lot of man is dependent on the earth's movements in space and on its power of self-adjustment to changing conditions, both internal and external. The combined rotation and revolution determine the weather and weather-changes in all parts of the earth, and thus control the habitability of the earth. The movements within the crust, which depend on its adjustment to the shrinking interior, provide for our many and fastidious needs.

The earth's atmosphere is apparently fickle and liable to great changes in composition, but the limits of its variation must be narrow. Its maintenance at the special composition breathed by animals, and that protects the earth from undue changes of temperature, is one of the beneficent functions of the sea. The efficiency of the atmosphere depends on its content of carbon dioxide, which is affected by many agencies. The sea acts as the great regulator of the atmosphere, and counteracts the disturbing factors; if too much carbon dioxide is taken from the air the bicarbonates in the water are dissociated and the sea breathes it forth until the standard proportion is restored. If volcanic activity or forest fires add an injurious amount to the air, the sea absorbs the excess and retains it as bicarbonates. The atmosphere is thus maintained at the special composition necessary for human respiration.

Man requires dry land that has been drained and left available for his occupation, and it would be of no use unless most of its surface were sloping. The land is constantly being lowered by wind and rain, and would in time be planed so level that the rain water would lie upon it and be removed only by the slow, chilling process of evaporation. But, thanks to the interaction of the crust and the shrinking interior, the surface is being lowered in some places and upheaved in others. The instability of the crust, which we deplore when an earthquake devastates a province or slays a hundred thousand people, renews the slopes on which the habitability of the earth ultimately depends.

The crustal movements by tilting the surface produce slopes which are essential for the flow of water and the formation of the grassy steppes where have evolved many of the animals most helpful to man, including those that supply wool and hair for clothing, meat and milk, and serve as beasts of burden.

Man also requires a soil that will produce the foods necessary for his nourishment; and soil is a delicate instrument that is easily exhausted and rendered infertile. The flow of water, though indispensable, charges the soil heavily for its service. Water is the most active of general solvents and removes in solution enormous quantities of the constituents essential to plant growth.

This process would in time leave only insoluble materials, and the soils would be barren and useless.

The earth is saved from this fate by the re-fertilisation of the soils from the primary rocks of the interior, which are rich in lime, alkalis, and phosphorus. Movements within the earth upraise igneous rocks to form highlands and mountains, and their constituents are washed down the slopes and renew the fertility of the lowland plains.

The tilting of the rocks on the surface in consequence of the internal shrinkage makes another essential contribution to the economy of Nature. Many of the most useful minerals lie in the old rocks, and if they were still horizontal the minerals would be so deeply buried that their discovery and economic working would be impracticable. But as the rocks have been tilted and folded the mineral seams are exposed on the surface, where they are easily found and can be profitably mined.

Hence the interaction of the different parts of the earth machine has rendered possible the evolution of man and still controls his destiny; for it keeps the earth's surface drained and habitable, it distributes the seas so that the land is supplied with rain and fresh water; it maintains the constituents of the air at the balance required in the breath of life, and it raises from the interior the minerals that renew the fertility of the soil and provide the mechanical engineer with the materials that have rendered possible the development of modern civilisation.

The Adequacy of Human Dietaries.

THE importance of the food supply in the preservation of normal health and well-being is generally recognised among scientific observers, but the necessity for a scientific selection of the food, in addition to that due to the dictates of appetite, is not always realised by many classes of the population. Dietary surveys, carefully performed, will indicate the adequacy, both quantitative and qualitative, of popular diets, in terms of accepted standards; when estimates of the cost of the diets are also made, data are available as to the minimum cost of an adequate food supply under different conditions. At the same time, encouragement may be given to education on the planning of adequate diets at minimum expense, especially if the surveys indicate that many dietaries are not only inadequate but also expensive.

J. B. Orr and M. L. Clark (*Lancet*, vol. 2, p. 594; 1930) have recently completed a survey of 607 families in seven cities and towns in Scotland. The information was collected from the housewives and is considered to be fairly reliable. For the calculation of the composition and energy value of the diets, Sherman's and Plimmer's tables were used. These tables allow for inedible material in the food purchased, but not for waste, for which 10 per cent should probably be deducted from the figures given for food consumption. Allowance must also be made for the fact that the food requirements of women and children differ from those of men; it is customary to express their requirements as a fraction of that of an adult man, taken as equal to 1, so that the 'man-value' of the diet of each family was calculated, using Cathcart's table. No account, however, was taken of the occupation of the adults. The mean man-value for each family was 4·86; the calorie consumption per man per day was 3609 cal., composed of 108 gm. protein, 574 gm. carbohydrate, and 86 gm. fat. The consumption in individual households varied widely from the mean, as shown by coefficients of variation of 20-30 per cent. Cases of insufficient calorie consumption were, however, relatively few; a larger number showed an intake of 4000 cal. per man per day or more, indicating either an unnecessarily high consumption or excessive waste. The average is slightly higher than that found in previous studies in Great Britain, but lower than in those carried out in other countries. Protein accounted for 12·3 per cent, carbohydrate for 65·5 per cent, and fat for 22·2 per cent of the calories.

A less satisfactory state of affairs was disclosed when the protein, calcium, phosphorus, and iron intakes were determined. The protein consumption was below the standard in about two-fifths of the families. The average figures found for the minerals were: calcium 0·86 gm., phosphorus 1·70 gm., and iron 0·0143 gm. per man per day. The figures for calcium and phosphorus are slightly above Sherman's estimates of an adequate intake, that for iron slightly below. About one-quarter of the families were receiving too little calcium and phosphorus, and nearly two-thirds too little iron.

Cathcart's figures for man-value are based on maintenance requirements; when a more stringent standard (Hawley's) was employed, which makes allowance for the fact that growing children require relatively more of certain constituents than adults, a larger number of families showed deficiencies in their intake of protein or minerals. In fact, most of the diets appeared incapable of supporting the optimum rate of growth.

The results of the survey probably explain, at any rate in part, the results obained by G. Leighton and M. L. Clark when extra milk was added to the diet of school children (*B.M.J.*, vol. 1, p. 23; 1929). It was found then that the addition of about a pint of extra milk daily to the diet was followed by an increase in the growth rate, indicated by increased weight and height as compared with the controls. Separated was as good as whole milk, but biscuits had no such effect; separated milk is a good source of protein and minerals, and to these a part at any rate of the good effect can be ascribed. Orr and Clark conclude that the dietaries of urban households can be considerably improved by the addition of milk to supply protein, calcium, and phosphorus, and of green vegetables to supply calcium and iron; both would also supply any vitamins deficient in a carbohydrate-rich diet.

F. M. Williams and J. E. Lockwood have carried out a similar survey among farm and village

families in Central New York, with the addition that the costs of the diets were also worked out (*Bulletin* 502, April 1930, Cornell University Agricultural Experiment Station, Ithaca, N.Y., U.S.A.). The survey in each family covered a period of four weeks and both bought and home-grown food was included, the cost of the latter being credited at current average wholesale prices. The standards used were similar to those employed by Orr and Clark, though the table for calculating the 'man-value' of a family with respect to energy requirements was not quite the same. In addition, an 'adequate food cost unit' was employed; this was obtained by taking the annual retail value of a diet supplying 3400 calories daily, a 'man's' requirements, as equal to unity, and expressing the cost of other diets as a fraction thereof. The adequate food cost scale was found to diverge slightly from the energy scale, especially in the case of children and when diets of low energy value were employed, since, for calories consumed, the cost of these is relatively high.

The analysis showed that 42 per cent of the village families and 64 per cent of the farm families were adequately fed. In many cases home-produced food made a substantial contribution to ensuring the adequacy of the diet and accounted for a considerable part of the retail value of the food consumed. In the inadequately fed families, it appeared that poor food selection rather than poverty was the cause of the poorness of the diet: the deficiency was most marked in the minerals, less so in the protein and calorie consumption. As in Orr and Clark's study, over-consumption was observed in a number of families.

The result of the study indicates the importance of proper selection of the food, and the addition to income represented by a supply of home-grown produce.

News and Views.

WHEN the Expiring Laws (Continuance) Bill came before the House of Lords on Dec. 15, Viscount Hailsham's amendment, which provided for the continuance of the Dyestuffs (Import Regulation) Act, 1920, until Dec. 31, 1931, was carried by 87 votes to 14. Viscount Hailsham sketched once again the circumstances attending the birth, decline, and revival of the industry in Great Britain. During the past ten years the progress made has been so remarkable that success appears to be the main argument used against the continuance of a protective measure. Although the Council of the Colour Users' Association expressed a majority opinion in favour of the lapse of the Act, the president of that Association holds the contrary view; any risk of undue exploitation in the matter of price is removed by the undertaking which the dye-makers have given. Lord Parmoor (Lord President of the Council) repeated the Government's view of the matter as involving conflict between dye-makers and dye-users. The dye-makers have been put into a position in which they can compete with imported dyes; they have built up a great industry, for which everyone is grateful, but the time has now come to make the change in the interests of the dye-user. The Earl of Crawford said that so far as research is concerned, this industry has been a triumph. Some of the most remarkable discoveries in organic science have been made by men working on dyestuffs. The industry is emphatically a key industry, is of great importance in defence, and is becoming the focus from which pharmaceutical progress radiates. The Marquess of Reading said that the matter is not one of free trade or protection; Lord Cowley claimed that the continuance of the Act would be a burden on the textile industry, a view which was challenged by Lord Newton, who showed how small is the cost of the dye contained in a suit of clothes. Lord Arnold, Paymaster-General, contended that the dye industry would not be injured. Hence the present situation, besides being of political interest, may lead to a comprehensive scientific examination of a scientific and industrial problem.

THE Slaughter of Animals Bill, which passed its second reading in the House of Commons on Dec. 12, would make compulsory in England the modern methods of slaughter already in vogue in Scotland, Holland, and elsewhere. This measure has been vigorously resisted for many years by the meat traders, but their opposition has now been withdrawn except as regards the inclusion of pigs. The questions at issue were mainly questions of fact which could be, and nearly all have been, settled by experiments and observation in a scientific way. In 1925 the meat inspectors of the City of London Corporation conducted trials on an extensive scale, and since then other trials of a scientific character have been carried out, notably that by Dryerre and Cameron of Edinburgh. It is to be regretted, therefore, that some members of Parliament attempted to deal with these matters of fact by means of disingenuous rhetoric. One member, for example, dramatically produced two skulls, as evidence of the relative merits of the poll-axe and the humane-killer; whereas the City of London meat inspectors had tested this point by observations on no fewer than 1745 animals. Again, Messrs. Marsh and Baxter circulated to every member a manifesto in which they alleged that the humane-killer causes 'blood-splash' in pigs, and quoted in support of this view veterinary opinions all dated 1923 or earlier; whereas in 1925 the City of London meat inspectors examined more than 700 shot pigs, and found that "in not one of them was splashing in the slightest degree observed". Humanitarians may learn a lesson from the rapid progress that has been made by the humane-slaughter movement in recent years. Most of its advocates have worked by patient insistence on verifiable facts, and its success has been far greater than that achieved by some other good causes in the promotion of which there has been recourse to exaggeration and rhetoric.

THE Pilgrim Trust, founded by Mr. Edward S. Harkness of New York, has made one of its first gifts to the Royal Institution. The Trustees have allocated

the sum of £16,000 to meet the deficiency on the fund for reconstruction of the building in Albemarle Street. In informing the Institution of this grant, the Trustees state that in making it they had regard to the distinguished scientific services rendered to the whole community for more than a century by the Royal Institution, and to the approaching Faraday celebrations. They were also not unmindful that the founder of the Royal Institution, Count Rumford, was of American origin. The provision of funds to meet the cost of the extensive programme of reconstruction which was forced upon the Managers has been a matter of the greatest concern to them and to every friend of the Institution. It will be recalled that, following a series of alarming explosions in Albemarle Street more than two years ago, the condition of the historic lecture theatre from the point of view of fire risks was shown to be such that reconstruction could no longer be deferred. Plans conforming to modern standards of fire protection, including the provision of suitable exits from the theatre, proved to involve the rebuilding, not of the theatre itself alone, but also of a large part of the structure surrounding it. After the fullest consideration, the work was put in hand at an estimated cost of not less than £80,000; now, as it is rapidly approaching completion, the actual cost is found to be upwards of £90,000.

THE aim has been to raise the sum required for reconstruction without drawing upon the existing funds of the Royal Institution and thereby crippling the already inadequate provision for research. In this the Managers have been successful, and by special measures, and with the generous assistance of private individuals, and of industries which have benefited, indeed in certain cases have their origin in the scientific work at the Royal Institution, they have raised a large fund. This, with the addition of the £16,000 from the Pilgrim Trust, is now sufficient to meet practically the whole cost of the rebuilding. The Institution is thus enabled to enter upon the year of the forthcoming Faraday celebrations and to look forward to a continuance of its work free from immediate financial embarrassment. With the cost of the rebuilding provided for, the Managers are free to turn their attention to another pressing object, the endowment of research. Some progress has already been made towards the establishment of a fund for this purpose. In the coming year it is hoped to add considerably to this fund, and thereby to place the scientific work of the Royal Institution and the Davy Faraday Laboratory on a financial footing which accords with the requirements of modern research.

FOUNDED in 1881, the Society of Chemical Industry will next year celebrate its jubilee, chiefly by means of proceedings of a domestic character associated with the annual meeting, which will begin on July 13 and extend over the succeeding seven days. It is intended to confer the rare distinction of honorary membership of the Society on a small number of eminent foreign technologists. It is also intended to present inscribed plaques to the original members of the Society and to the prime wardens or masters of such livery companies of the City of London as have specially fostered the education or progress of applied science. In addition to the social engagements appropriate to such an occasion, there will be arranged exhibitions of apparatus and plant and visits to works typical of the manufactures of London. Two special publications are being prepared in honour of the jubilee. Dr. Stephen Miall, editor of *Chemistry and Industry*, is writing a comprehensive history of the chemical industry, whilst a special number of the Society's *Journal* will include reprints of the outstanding papers which have appeared during the fifty years of its existence. The progress of chemical industry and that of the Society itself will be outlined, and use will be made of the opportunity for biography. These publications will be available to the general public, for whose information and interest there are also being arranged a series of broadcast addresses and the distribution of authoritative articles dealing with the relation of chemistry to life and industry.

THE International Conference on Silicosis held at Johannesburg on Aug. 13–27 last has an interest quite apart from the valuable conclusions reached in its study of the medical aspects of this dangerous industrial disease. The Conference, which was summoned by the International Labour Office with the assistance of the Transvaal Chamber of Mines and the Government of the Union of South Africa, was the first held outside Europe under the auspices of the League of Nations, and was also the first experiment in co-operation between the International Labour Office and the scientific world. Delegates from Germany, Australia, Canada, Great Britain, Italy, Holland, the Union of South Africa, and the United States of America participated in the work of the Conference, which, in addition to the opportunity of exchanging views and comparing practice, enabled the delegates to obtain personal acquaintance with the achievements of the Miners' Phthisis Bureau of South Africa. An average of £1,000,000 per annum is spent by the mining industry of the Rand in medical care and compensation for silicosis, and Mr. Sampson, the Minister of Posts and Telegraphs, in opening the proceedings, stressed the value of international co-operation in combating this disease.

THE recommendations of the International Conference on Silicosis were adopted as a result of discussion upon reports presented upon three groups of problems: prevention, medical aspects, and compensation—the greater part of the sessions being devoted to the discussions in these groups. Among the recommendations of chief interest to scientific workers are those which urge the absolute necessity of scientific research, and particularly research designed to secure uniformity of terminology and of radiological technique. The collection of further information concerning the incidence and development of the disease and the study of methods of rehabilitation was urged, and the Conference requested the International Labour Office to publish periodically a bibliography on silicosis. The Conference sets a

precedent that might well be followed more widely in the co-ordination of scientific research on social and industrial subjects.

IN connexion with the International Conference for Phytopathology and Economic Entomology held in Holland in 1923, prizes were offered in 1928 for the best two memoirs concerning (1) investigations on rust diseases (Uredineæ) of cereals, and (2) investigations on the rôle played by insects or other invertebrates in the transmission or initiation of virus diseases in plants, the prizes being of the value of 1000 Swedish crowns (about £55) each. It is now announced that the prize for the most meritorious investigations on Rusts has been awarded to Mr. J. H. Craigie, Senior Plant Pathologist in Charge, Dominion Rust Research Laboratory, Winnipeg, Manitoba, Canada. Mycologists will recollect that it was Mr. Craigie who recently discovered the hitherto unknown and important function of the spermogonia of the rust fungi. The adjudicators have made no award in connexion with the subject of the second prize.

ONE of the most interesting developments in high voltage engineering is the use of a method by means of which cables are kept constantly impregnated with oil. As the temperature of the cables is continually altering owing to variations in the load, it is necessary to provide means so that when the cable is hot it is relieved of the excess oil caused by expansion due to temperature and when cold the oil is returned to it. For this purpose feeding tanks have to be supplied when the level of the cable is high and pressure tanks when the level is low. These cables seem to be opening up a new era in power transmission and they are being very closely studied. In the *G.E.C. Journal* (England) for November is published the second of a series of articles by E. H. Horley on the manufacture and testing of the accessories used in oil-filled cables. He points out that the length of the cable which can be supplied from one feeding tank is limited by the viscosity of the oil and the resistance the central channel in the cable offers to the flow of oil along it. The length of this section can be increased considerably by using a pressure tank to assist the feeding tank by taking in oil during the first period of the heating of the cable and sending it out during the first period of the cooling. This is done by constructing cylinders containing flexible walled cells made of corrugated nickel plates. The number of these cells corresponds to the amount of oil required to operate the section of the cable. To test a cell, it is subjected to 10,000 cycles of rarefaction and compression. The test is done automatically for a few days and nights, and is equivalent to several years of actual working. Every length of cable dispatched from the factory has a tank filled with oil under pressure connected with it.

As Italy has practically no coal resources, it has to import nearly all its own coal. Since the War, the price of coal in Italy has fluctuated between wide limits. At the present time it is about thirty shillings per ton. One of the objects of electrifying the railways in Italy was to utilise the water power available in the mountainous regions and thus reduce the importation of coal. Last year the saving effected in amount of imported coal required was about 20 per cent, and the average water power developed exceeded two million kilowatts. During the thirty years since electric traction first began to be used, much experience has been gained on the electric systems in use. G. Bianchi read a paper on this subject to the Institution of Electrical Engineers on Nov. 20. Up to 1916, 230 miles of the railways had been electrified on the three-phase system at 16 cycles. A drawback to this system was that it required exclusive generating stations fairly close together and so further electrifications after 1916 were carried out on the three-phase system at the standard industrial frequency of 45 cycles. The energy was converted into direct current of 3000 volts before reaching the motors of the locomotives, as this has the advantages of simplicity of the overhead contact line and great ease in speed regulation. It was originally intended to confine the 3000 volt d.c. system to the lines of southern Italy, but it has now been decided to carry out the electrification of the Florence-Rome and of the Milan-Bologna lines on this system. When this is done, there will extend from Milan to Naples an electric line which, traversing the peninsula from north to south, will carry the greatest part of the longitudinal traffic of the Italian railways. In order to meet the eventuality of a substation break-down which cannot be repaired in a short time, travelling sub-stations have been constructed. These travelling sub-stations have proved so useful, both from the technical and economic points of view, that it seems probable that they will come into continuous use.

IN two addresses to members of the Eugenics Society in association with the Psychology and Education Sections of the British Association at the Bristol meeting, Prof. R. J. A. Berry, Director of Medical Services in the Stoke Park Colony, Bristol, discussed the physical basis of mind and the diagnosis of mental deficiency. His addresses are summarised in the October number of the *Eugenics Review*. He points out that probably 80-90 per cent of primary mental deficiency is due to bad heredity. In mental defectives it is the pyramidal cells of the controlling supragranular cortex of the brain which are chiefly lacking, while those controlling the animal instincts of self-preservation and sex are often well developed. Mental defectives are usually more or less markedly microcephalic owing to the small development of the brain. Several striking cases were described, illustrating the various types of arrested mentality—the idiot, the imbecile, and the feeble-minded. The various physical and mental tests applied in determining the mental condition are also described. A feeble-minded woman thirty-two years of age may have the brain of a girl of six years and the mental capacity of one of eleven years, combined with bodily growth at the fourteen-year level and the sexual passion of an adult. Lack of control of the natural reactions is the inevitable result. Prof. Berry states that in Great Britain we are spending some £93 per head per annum on mental defectives, who frequently are allowed to reproduce their kind,

while we spend only £12 per head on the normal child. Thus does civilisation bring about its own downfall.

REFERRING to the correspondence under the heading of "Highest Recorded Shade Temperature", on p. 723 of NATURE for Nov. 8, Prof. A. J. Henry gives some further interesting particulars of the conditions under which a temperature of 134° F. was recorded at Greenland Ranch, Death Valley, California, on July 10, 1913. On the day in question there was a slow drift of air from the north, that is, from the high plateau of Nevada, which reaches a general elevation of 6000-8000 ft. On this bare continental plateau the temperature probably approached 100° F., in spite of the elevation. Death Valley itself lies below sea-level, and in its steep descent of several thousand feet from the Amargosa and Funeral Mountains the air was warmed dynamically to a most abnormal temperature. The extreme conditions occurred only in Death Valley, which is a long, narrow trough running north and south, while in other parts of California the day was not especially hot; but these considerations justify the acceptance of the record. Unfortunately, there is not sufficient information available in Great Britain to examine the Azizia record in similar detail, and Prof. Henry is still sceptical as to its reality.

INQUIRIES are often made by amateur naturalists as to how, without starting upon some intricate investigation, they may add new facts to the sum of knowledge. To such and to their advisers we commend an article in the November issue of *British Birds* on "Our Present Knowledge of the Breeding Biology of Birds", by the Rev. F. C. R. Jourdain. The author emphasises the lack of information which at present exists about the length of the incubation period in many common birds, and about that interesting and variable detail, the parts taken by the cock or hen or both in sitting upon the eggs and later in tending the young. The information given is of real value as a guide to the potential investigator, for not only does the article contain a list of the birds concerning which further observations are required, but also it states the form which the observations ought to take. Readers familiar with the immense amount of literature which has been devoted to the birds of the British Isles will be amazed at the number of blanks which occur in the records of incubation and fledgling periods of common birds.

IT is highly probable that in the future tidal power will be used extensively. In most industrial countries, however, the low cost of coal and the progress made in the technique of coal burning imposes a severe restriction on its development, except in a few very special cases. The main problem that has to be overcome is to find an economic way of getting a continuous supply of energy from a variable source. An experimental attempt is being made at the Avonmouth docks (NATURE, Oct. 4, p. 541), where the tidal range is about 30 feet; of this, about 10 feet cannot be used by the turbines and recourse is had to a steam accumulator which has been 'charged' by the tidal turbines. In *World Power* for November, two tidal projects in the Argentine are described, one at the mouth of the Deseado River, and the other at the Gulf of San José. The Argentine has a difference between high and low tide levels sufficient to justify the consideration of a tidal scheme and a Government commission has reported favourably on it. In the Gulf of San José, the sea rises 15 feet in neap tides and about 26 feet in spring tides. By a special arrangement the turbines can be made to run in the same direction whether the tide is going out or coming in. It would be possible to have five hours' continuous operation out of every six.

A NEW high-tension power line, costing more than one million pounds sterling, between Toronto and the Paugan Falls electric generating station, a distance of 230 miles, has just been brought into operation by the Ontario Hydro-Electric Power Commission. The voltage of the transmission line is 220,000, which is the highest yet adopted in Canada. In transmitting 150,000 horse-power, the line is also believed to carry the greatest volume of electric energy. It is used to supplement supplies received from Niagara Falls, the station generators at which are now working in perfect synchronisation with those at Paugan Falls. The new line is carried on steel towers, 73 ft. in height, placed at distances apart of about one-fifth of a mile. It is the second of two service lines from Paugan Falls to Toronto. Both are of aluminium with a steel core, the external diameter being $1\frac{1}{8}$ inches. It is interesting to note that the route was planned with the aid of aerial photography. Located in the first instance from the best available maps, the route was photographed with oblique exposures, after which a definite line was selected. This was then re-flown and vertical photographs taken, from which a mosaic map was made for detailed study and the selection of tower sites. It has been, in fact, an important application of the aerial survey method, and it resulted in a considerable saving of time.

MR. SIDNEY SMITH, Assistant Keeper in the Department of Egyptian and Assyrian Antiquities at the British Museum, has been appointed Keeper of the Department in succession to Dr. H. R. Hall, who died on Oct. 13 last.

WE much regret to record the following deaths: Mr. A. B. Basset, F.R.S., a vice-president in 1892–94 of the London Mathematical Society, on Dec. 5, aged seventy-six years; Sir Otto Beit, Bart., K.C.M.G., F.R.S., well known for his generous benefactions for medical and other scientific research, on Dec. 7, aged sixty-five years; and Sir Francis Ogilvie, C.B., formerly Director of the Science Museum, South Kensington, on Dec. 14, aged seventy-two years.

THE Christmas Lectures at the Royal Institution will be delivered this year in the reconstructed lecture theatre of the Institution by Prof. A. M. Tyndall, H. O. Wills professor of physics in the University of Bristol, on the electric spark. The first lecture will be given on Dec. 30, at three o'clock, on "Some Properties of Electrified Bodies". The remaining five lectures will deal with the spark as a

current of electricity, air as a conductor, and the mechanism and properties of sparks and arcs.

As already announced, the twenty-first Annual Exhibition of the Physical and Optical Societies is to be held on Jan. 6-8 at the Imperial College of Science, Imperial Institute Road, South Kensington; it will be open in the afternoon from 3 P.M. to 6 P.M., and in the evening from 7 P.M. to 10 P.M. To mark the coming-of-age of the Exhibition, it will be opened formally by Sir Arthur Eddington, on Jan. 6 at 2.30 P.M. Two discourses, with experiments, will be given at 8 P.M. on Jan. 7 and 8: Mr. E. Lancaster-Jones, "Searching for Minerals with Scientific Instruments", and Sir Gilbert Walker, "Physics of Sport". Members of learned societies can obtain tickets of admission from their secretaries; others may obtain tickets on application to the Secretary, the Physical and Optical Societies, 1 Lowther Gardens, Exhibition Road, London, S. W.7. No tickets are required for Jan. 8.

DR. T. A. STEPHENSON, senior lecturer in the Department of Zoology at University College, London, has been appointed professor of zoology in the University of Cape Town in succession to Prof. L. T. Hogben. Prof. Stephenson received his education in zoology and allied subjects at the University College of Wales, Aberystwyth, where he was afterwards demonstrator in zoology for about three years. His earlier research work was on the morphology and ecology of the sea anemones, and more recently he has studied the ecology of corals and coral-reefs; in 1923 he made an investigation of the Guernsey *Haliotis* fishery. In 1928–29 he was in charge of the shore-work of the Great Barrier Reef Expedition. Prof. Stephenson is the author of various publications dealing, among other subjects, with the Actiniaria of the world and British orchids, but his principal item is Vol. 1 of a monograph on the British sea anemones, which is one of the Ray Society publications.

THE annual meeting of the American Association for the Advancement of Science will be held at Cleveland on Dec. 29–Jan. 3. This will be the fourth occasion on which the Association has met at Cleveland. The address of the retiring president, Dr. Robert A. Millikan, director of the Norman Bridge Laboratory of Physics and chairman of the executive council of the California Institute of Technology, will be delivered on Dec. 29. Dr. Edwin B. Wilson, professor of vital statistics in the School of Public Health, Harvard University, will deliver the Gibbs lecture (under the auspices of the Association and the American Mathematical Society) on the afternoon of Dec. 30; and Dr. C. E. K. Mees, of the Eastman Kodak Company, will give the Sigma Xi lecture on the same evening. General lectures have been arranged for every afternoon and evening of the meeting, and a science exhibition will also be open. It is also announced in *Science* that the first of the new series of summer meetings of the American Association for the Advancement of Science will be held at Pasadena, California, on June 16-20, 1931, at the California Institute of Technology, the Huntington Library and Art Gallery, and the Mount Wilson Observatory.

ON Nov. 10, the University of Colorado celebrated the twenty-fifth anniversary of the theory of relativity; it was on Sept. 26, 1905, that Einstein's first paper on relativity, entitled "Zur Elektrodynamik Bewegter Körper", appeared in the *Annalen der Physik*. A banquet was given in the Memorial Union Building, after which addresses were given by various members of the faculty. Dean O. C. Lester, of the Graduate School, spoke on "The Changed Outlook on Physical Theories"; Dr. V. P. Lubovich, assistant professor of physics, spoke on "Does the Inertia of a Body depend upon its Energy Content?"; Dr. Walter B. Veazie, of the Department of Philosophy, discussed "Relativity and Philosophy"; and Dr. Frank E. E. Germann, professor of chemistry, spoke on "Chemistry and Relativity". A painting of Dr. Einstein by Miss Virginia True, of the Art Department, was also unveiled.

THE Augustus and Alice Waller Memorial Research Fund is held in trust by the Council of the London (R.F.H.) School of Medicine for Women, but is not restricted to members of that institution. A permanent income of about £100 a year is provided for the primary purpose of making grants, usually of small sums, for the purchase of research apparatus. Twenty-nine grants representing a total sum of £540 have been made, varying in amount from £3 to £48, the average grant being £18. The grants have been given for research work in physiology, physics, chemistry, anatomy, pharmacology, and pathology. It is felt that the Fund is fulfilling its purpose as a memorial to Dr. and Mrs. Waller, who themselves devoted their lives to research. The sum of £105, with accrued interest, subscribed for a memorial at St. Mary's Hospital, will be used to help equip one of the physiological laboratories in the new school to be known as the "Waller Memorial Laboratory". It is expected that the laboratories will be completed in about eighteen months' time.

THE report of the Irish Radium Committee for 1929 has been published by the Royal Dublin Society (*Sci. Proc. Roy. Dub. Soc.*, vol. 19, [separate issue] No. 42). The large quantity of 14,730 millicuries of radon was issued during the year. Reports from several surgeons are included, and some surprisingly good results are recorded in some cases of cancer of the breast, lip, and skin, and in one of pelvic sarcoma, though it has to be admitted that there are numerous failures. In some of the latter, nevertheless, the patient's condition for the time being is often much benefited.

THE first number of a new periodical, *Bulletin Météorologique de l'Observatoire Météorologique de Beograd*, dated 1928, has recently been received. Its contents, however, consist of the daily observations of the various meteorological elements at 3 hours on each day at numerous stations in Serbia during the half year July–December 1905. The *Bulletin* is a sequel to two former publications, one—the monthly bulletin

of the Belgrade Observatory which was published for the period 1902–June 1905, and the other a separate publication giving data from 1904–June 1905. The Observatory archives contain data, for the most part not reduced, for the whole period 1888–1914. It is hoped to publish these and later data in further issues of the *Bulletin*, so that in twelve to fourteen years the whole material will be made available. Meteorologists in other countries will join in wishing that this modest hope may be fulfilled.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant master for mathematics and physics in the Smith Junior Nautical School, Cardiff—The Director of Education, City Hall, Cardiff (Dec. 27). An assistant science teacher at the Central Municipal Technical School, Liverpool—The Director of Education, 14 St. Thomas Street, Liverpool (Dec. 31). A male assistant under the Department of Scientific and Industrial Research for work in connexion with research on fruit—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (Dec. 31). A professor of pathology in the University of Glasgow—The Secretary, The University Court, University, Glasgow, W.2 (Jan. 7). A graduate woman teacher for arithmetic and geometry at the Bloomsbury Trade School, Queen Square, W.C.1—The Education Officer (T.1), County Hall, S.E.1 (Jan. 9). A research assistant in plant breeding at University College, Dublin—The Secretary, University College, Dublin (Jan. 15). A mechanic and laboratory assistant in the physics laboratory and workshop of the University of Cape Town—The Registrar, The University of Cape Town, P.O. Box 594, Cape Town, South Africa (Jan. 20). A professor in mathematics in the University of Dacca, East Bengal—The Registrar, University of Dacca, East Bengal, India (Feb. 7). A professor of economics and political science at the University College of Wales, Aberystwyth—The Financial Secretary, University College of Wales, Aberystwyth (Feb. 14). A principal of the Dundee School of Economics and Commerce—The Town Clerk, Dundee.

Our Astronomical Column.

A Solar Eruption on Nov. 25.—At the meeting of the Royal Astronomical Society on Dec. 12, observations were described of a solar eruption that was seen near the centre of the sun's disc on Nov. 25 with the spectrohelioscope at Greenwich. Eruptive prominences possessing velocities of 100 km./sec. or greater have been often observed in hydrogen light at the sun's limbs with the spectroscope by recording their linear displacements with time. Similarly they are recorded in spectroheliograms in hydrogen or calcium light. The spectrohelioscope in addition enables the observer to follow the changes of the prominences as they are carried by the sun's rotation across the disc as absorption markings. A simple device for progressively changing the wave-length of the light entering the eye enables the observer to locate and measure the line of sight component of the radial velocity outwards or inwards from the sun with which the absorption marking may be moving.

The phenomena observed on Nov. 25 evidently represented the end-on view of an eruptive prominence blown out of the sun's chromosphere with a maximum observed velocity of 450 km./sec. Forty-five minutes before the eruption, an apparently stable dark marking was visible; at $10^h\ 34^m$ G.M.T. the velocity rose within a few minutes from 40 km./sec. to about 400 km./sec. At 11^h cloud stopped the observations, but the eruption was then declining, and part of the gaseous structure was descending at about 100 km./sec. Contemporary with the appearance of those rapidly moving masses of hydrogen gas, brilliant patches of hydrogen with little or no radial velocity made their appearance. It may be added that the phenomena described could have been photographed with a spectroheliograph had the second or selecting slit been set at appropriate distances from the $H\alpha$, or H or K lines of the solar spectrum so as to allow for the Doppler displacements equivalent to the velocities observed.

Autumn Fireballs.—Mr. W. F. Denning, 44 Egerton Road, Bristol, writes as follows: "Several large fireballs or meteors have been observed during the last two months, and further observations of the following would be welcomed:

Oct. 24, 8.24: Brilliant meteor, fell perpendicularly down in southern sky, seen at Bristol.

Nov. 16, 9.46 P.M.: Estimated four times as bright as Jupiter; path, 165° +55° to 135° +35°; duration 5 sec.; seen from Nuneaton, Warwick.

Nov. 16, 2.30 A.M.: Splendid meteor, gave a brilliant flash and left a fiery streak for several minutes; appeared in the eastern sky and moved from north to east; fell at angle of 45°; Campbeltown, Scotland.

Oct. 30, 10.5 P.M.: A fireball passed along parallel to the horizon eastwards; altitude low, first seen when slightly east of the moon and endured 8 to 10 seconds; disappeared in the south-south-east; observed by several people from Edinburgh and described in the *Scotsman*.

Nov. 27, 11.6 P.M.: Reported by observers in Cornwall and Devonshire; it lit up the whole countryside. As seen at Lostwithiel, it moved from north-west to south-east and ended near Orion; as viewed from St. Agnes, it shot almost perpendicularly down the southern sky and traversed the region of Perseus or border of Aries and Taurus and vanished near Orion."

Stellar Absorption Band near λ4200.—Recent work by Dr. A. V. Douglas, described in the *Monthly Notices* of the Royal Astronomical Society for October 1930, throws some light on the discussion concerning the origin of this band. Previous work by Elvey and Zug showed that in the case of the Yerkes spectrograms its presence in stellar spectra could be accounted for by absorption in the optical system. Shapley, also, has withdrawn his earlier identification of cyanogen as the origin in early type stars. Miss Douglas, by means of experiments similar to Elvey's, has been unable to trace any selective absorption in the optical train of the Ottawa 15-inch refractor; whereas, in the case of three cepheid variables examined by her, the absorption band is not only strong but also exhibits periodic variations in intensity in phase with similar variations of enhanced lines. The stellar origin (most probably cyanogen) is thus strongly supported. No mention is made of early type spectra, and the origin in such cases is still not definitely settled.

Research Items.

Megalithic Structures in Ceylon.—In the course of his archæological summary in the *Ceylon Journal of Science*, vol. 2, pt. 1, Mr. A. M. Hocart reports the existence of a dolmen at Padiyagampola, near Rambukkana, the only one of its class that has so far been discovered in Ceylon. It was brought to the notice of the Archæological Department by Mr. F. Lewis, of Kandy, and is situated on the foothills of the central mountain range of the island. It is constructed of three upright slabs with a covering stone placed horizontally on them. The two long upright slabs measure roughly 12 ft. by 5½ ft. each; the upright stone at the north end measures 3½ ft. by 5½ ft. The covering stone, irregular in shape and measuring 17 ft. by 15 ft., is in a somewhat 'slanting' position and has cracked. The thickness of the slabs is about 15 inches. The room measures internally 11 ft. by 6½ ft., and the height from the present ground level to the covering stone is 6 ft. The southern side is open and there is a passage on the north side also. The stones bear no marks of chiselling, except on the western side, but this is probably not an original feature. Trilithons still survive in Ceylon, where they are called *gonatu*. A Sinhalese statement says that "when pregnant women die, they are reborn as *bodiri* birds. *Gonatu* are made to liberate them from this. Wayfarers place on top the loads that they carry either on their heads or shoulders, and sit by and rest. By that grace the women who are born as *bodiri* birds are liberated from that, and are born in a better world." It is interesting to compare with this the fact that the great trilithon of Tongatabu is known in Tongan as the "Burden of Maui".

Pueblo Ruins in Colorado.—The excavation in 1928 of early Pueblo ruins belonging to the period known as Pueblo I, in the Piedra River district of south-western Colorado, is described by Mr. Frank H. H. Roberts, jun., in *Bull.* 96 of the Bureau of American Ethnology. The Piedra River is one of two cultural sub-centres in the San Juan Basin—one of the more important minor districts of Pueblo culture—the other being Aztec. The latter, however, towards its final period came under the domination of the Mesa Verde peoples. The Piedra River district was virtually unknown to archæologists before 1921. Early excavations up to 1923 and surveys in later years did little more than show the great importance of the district as an archæological site. Ruins and sites extend along both banks of the river for a distance of more than 15 miles. Three types of houses were found, but while the first is thought to show a late Basket-Maker influence, the two later illustrate definite pueblo forms of the early period. The outstanding constructional development of the period was that of the rectangular, perpendicular-walled building which made possible the joining of single-roomed houses into a communal dwelling of many contiguous rooms, one of the typical features of the true pueblo complex. Ruins of only two of the ceremonial kivas were uncovered—an unusually small number of specialised ceremonial rooms for so large a number of house-group units. This is taken to suggest that this feature of pueblo culture was still in a developmental stage. The pottery also shows that that industry was in a transition stage. Among the most significant new features are the banding on the necks of the vessels, the shift from banded to coil ware, the use of a slip, and the elaboration of painted decoration. Bone and stone implements were not abundant, and consist of a few general forms. Burials were in the contracted position and accompanied by mortuary offerings of pottery.

Insect Control by Aeroplane.—*Circular* 123 (issued August 1930) of the United States Department of Agriculture describes the relative values of dusting the blueberry crop, when infested by larvæ of the fly *Rhagoletis pomonella*, by aeroplane and by ground machines. The authors, Messrs. F. H. Lathrop and C. B. Nickels, state that trials carried out in the State of Maine indicate that calcium arsenate is effective as a dust in controlling this insect. Under favourable conditions, when this material is discharged from an aeroplane flying at a height of about 25 feet, at a speed of 60 miles per hour, the results are as effective as when it is delivered on the crop by ground machines. In the case of this particular insect pest, however, the balance was rather in favour of the latter method. The general topography and the usual atmospheric conditions were against the use of the aeroplane. Heavy fogs during early morning, at the time when the aeroplane could be most favourably used, reduced the length of period available, and it was doubtful whether enhanced speed compensated for the shortness of the time when the aeroplane could be employed.

Parasites of the Pine-shoot Moth.—In the *Bulletin of Entomological Research*, vol. 21, October 1930, pp. 387-412, Dr. W. H. Thorpe describes the results of a preliminary study of the parasites of the pine-shoot moth (*Rhyacionia buoliana*). The investigation was undertaken at the request of the Dominion Entomologist of Canada, where the experiment of attempting to control that insect by biological methods is being undertaken. Although the moth is by no means kept under complete control by parasites in Europe, it was considered possible that the introduction of certain of the more important of these enemies, free from their natural hyperparasites, might result in checking the spread of that pest in Canada. The investigations were carried out at the Farnham House Laboratory of the Imperial Institute of Entomology on material obtained from Norfolk, Suffolk, and the New Forest. It appears that twenty-eight species of primary and secondary parasites affect the insect in question, of which the dominant or 'key' forms appear to be the Braconid *Orgilus obscurator* and the two Ophionines, *Cremastus interruptor* and *Omorgus mutabilis*. Consignments of these species have been transmitted to Canada, where the first two mentioned have become established and have been able to pass the severe winter successfully. A brief account is given of the salient features in the biology of each species, and the chief diagnostic characters of the adults are described, along with those of the mature larvæ. The practical outcome of the experiment will be watched with interest, but some years must elapse before any definite results are forthcoming.

Trematodes of the Dry Tortugas.—Mr. O. R. McCoy has continued his investigations into the life-histories of marine trematodes (Year Book No. 28, Carnegie Institution of Washington, p. 290). Special attention was given to the behaviour of certain cercariæ and some interesting experiments were carried out. Three new monostome cercariæ with large, more or less highly pigmented tails and pigmented eye-spots, all infesting the gastropod *Cerithium litteratum*, were studied. The full-grown active larvæ of each species are strongly photo-positive, and in one species the cercariæ aggregated in masses, the individuals of which moved together as a unit. The posterior half of the tail tapers suddenly to form a sticky ribbon and the tails become tangled together, the head ends of the animals projecting outwards. It is suggested that

such aggregations occur naturally in the branchial chamber of the mollusk. On p. 295, Mr. H. M. Miller and Mr. O. R. McCoy describe their experiments on the behaviour of *Cercaria floridensis* in relation to its intermediate hosts. This larva is also photo-positive, and swims towards the light if any shadow fall upon it, the habit apparently influencing considerably any experiments. Several species of small fishes known as 'grunts' (*Hoemulon* spp.) were successfully infected, the trematodes encysting under the scales and in the fins.

Paryphantidae of New Zealand.—The larger New Zealand land snails belonging to the genera *Paryphanta*, *Wainuia* (n. gen.), and *Rhytida* have now been recorded and described in full detail by A. W. B. Powell (*Rec. Auckland Inst. and Mus.*, vol. 1). How the distribution of the species is governed by present physical features and what their hypothetical ancestry and development may have been are also discussed. *Rhytida* and its close allies have a far wider range than *Paryphanta* and consequently a probably greater antiquity and more ancient dispersal. *Paryphanta* doubtless originated from *Rhytida*-like stock within the New Zealand faunal area and achieved its greatest distribution during the great land extensions of the Lower Cretaceous, reaching Tasmania and Victoria, Australia. The single new species described, *Paryphanta superba*, is the largest of the genus and indeed of the group under discussion; so, that it has hitherto escaped discovery is somewhat remarkable.

The Crab Genus *Actæa*.—Mr. Lee Boone makes some interesting remarks on these crabs, belonging to the Pilumnidæ, in a paper entitled "Notes on the West Indian Crabs of the Genus Actæa" (*Bulletin of the American Museum of Natural History*, vol. 61, art. 3; 1930). He believes that *Actæa bifrons* Rathbun is merely the young of *Actæa setigera*, but as Miss Rathbun, in her recent work on "The Cancroid Crabs of America", amongst the material examined records an ovigerous female of *A. bifrons*, this seems somewhat doubtful. The species of *Actæa* are all very hairy and live in cavities of corals and sponges. Always sluggish in their movements, they are easily overlooked. For the first time, detailed colour notes are given of a specimen of *Actæa acantha* and of the West Indian representative of *A. rufopunctata nodosa*.

Respiratory Products and Plant Regeneration.—K. Kakesita in the *Japanese Journal of Botany*, vol. 5, No. 2, 1930, advances the view that the regenerative activity of the leaf of *Bryophyllum calycinum* may be stimulated by the accumulation of the products of intramolecular respiration within the leaf tissues. This view is suggested as the result of experiments, in which the leaf, still attached to the plant, was caused to produce buds and roots by placing the whole plant in a warm bath, or in an atmosphere of hydrogen. Injection of substances regarded as likely products of such intramolecular respiration, especially ethyl alcohol, is also said to have produced regenerative activities. Evidence is supplied that acetaldehyde and alcohol accumulate in the plant as the result of the warm bath treatment or as the result of surrounding the plant with hydrogen. More acetaldehyde and alcohol were also found in isolated than in attached leaves, so it is suggested that regeneration, as the result of isolation, is also the result of intramolecular respiration in the leaf tissues.

Root Stock Influence.—In the case of British fruit trees, every orchard is filled with worked trees, in which a desirable scion is grafted upon a root system, derived either from another seedling or a vegetatively propagated 'clone' which roots relatively readily. Of recent years the East Malling Experiment Station has emphasised the possibility that propagating a scion 'clone' upon a suitable root stock 'clone' might go far to standardise growth and yields in orchard practice. An examination of stock scion relationships, therefore, by the Director of the East Malling Experiment Station, Mr. R. G. Hatton, in the Masters Memorial Lectures, published in the *Journal* of the Royal Horticultural Society for September, may be expected to summarise the results of experimental work in this interesting field, and the reader will not be disappointed. Some American workers are more inclined to stress the influence of the common scion in impressing uniformity upon the variable seedling material used as source of roots in American practice, and Mr. Hatton points out that this may be the result of the different method of working in the two countries. Much American material is 'bench-grafted' upon root pieces, whilst English unions are made by budding or grafting upon the stem of the stock above ground-level. Mr. Hatton supplies evidence of root stock influence upon scion yield, vigour, and habit of growth under the English method of working. He also examines the possibility that this influence may be in part due to the stem piece of the stock left above its root system, and finds some evidence, in double worked trees, that the intermediate piece of stem may influence the character of the scion above. This argument, if capable of extension, would seem likely to give away the case. If, as is argued, five or six feet of the stem of a vegetatively propagated intermediate can largely produce uniformity, even when the intermediate is worked on seedling stocks, then the conclusion would seem to be that the same uniformity might be expected if the stem piece belonged to the scion. A very useful bibliography is appended.

Bathymetry of the Oceans.—In the *Hydrographic Review* for November, Lieut.-Com. H. Bencker has a paper on the bathymetry of the oceans, in which he discusses the material available for detailed charts. The most valuable part of the paper, however, lies in the appendices. The first of these is a chronological list of the important vessels from 1800 onwards which have contributed to deep-sea knowledge. The dates of foundation of various oceanographic and other institutes are also noted. Following this list is a catalogue of ocean deeps as known up to the present. These are listed under oceans, with the latitude and longitude of the greatest depth. Each is given the generally accepted name. There is also a list of important shoals of all oceans unconnected with continental land masses or islands. These lists are not complete in all details but are published in the hope that any inaccuracies or omissions will be noted and a communication sent to the International Hydrographic Bureau at Monaco.

Earthquakes at Ito (Japan).—The remarkable series of slight earthquakes, 3684 in number from Feb. 13 to April 11, at Ito, on the west coast of Sagami Bay, are described in a previous note (NATURE, Aug. 30, p. 326). While the earthquakes were occurring almost incessantly, a new series of precise levellings was carried across the district. Comparing the measurements with those made in 1924, it appears that, close to Ito, a tract of coast 12 miles long has risen, by so much as 3 ft. 2 in. at a point two miles south of Ito, while at either end of the tract there has been a slight subsidence, of 4 in. to the north and 10 in. to the south (*Earthq. Res. Inst. Bull.*, vol. 8 pp. 375-376; 1930).

Non-metallic Ore Deposits of Russia.—An important work on this subject has been published—under the editorship of I. I. Ginsburg, S. V. Konstantinoff, I. D. Kourbatoff, V. A. Unkovsky, A. E. Fersmann, and D. I. Shcherbakoff—by the Academy of Science of U.S.S.R. (Leningrad, 1926–29: 4 volumes, in Russian). Altogether there are seventy-five original articles, each dealing with compounds of an element or a group of elements, written by a specialist in a given subject. Each article contains the following features: a general description of the mineral and the ore, together with its chemical and physical properties, occurrence in U.S.S.R. and elsewhere, mining and working of the material, technical applications, world markets and prices, and also a special part devoted to a detailed description of Russian occurrences. A comprehensive list of the literature, both Russian and foreign, is included with each article. Indexes and table of contents are included in every volume. This important publication can be recommended as an authoritative source of information to all interested in Russian mineral wealth and industry.

The Michelson-Morley Experiment.—A repetition of the experiment of Michelson and Morley on ether-drift has been carried out by G. Joos at Jena, and is described in a recent paper (p. 385) in the current volume of the *Annalen der Physik*. Several novel features have been introduced in the mechanical and optical arrangements. The frame for the support of the mirrors was built of quartz slabs (made by Schott), the light-path being 21 metres. Transmission of vibrations was avoided, not, as has often been done previously, by floating in mercury, but by hanging the interferometer on a great number of springs, oscillations of the suspended system being damped by hairs. The fringes were recorded by photography and measured up in a microphotometer, the final result being that any effect due to an ether-wind was less than 1/1000 of a fringe, or that the ether-wind is less than 1·5 kilometre per second.

Measuring an A.C. Voltage by balancing against a D.C. Voltage.—In the *Journal of Scientific Instruments* for December, S. Whitehead and D. Barham give an account of very interesting experiments showing how an a.c. voltage may be measured by means of a quadrant electrometer and a d.c. potentiometer. The method used is a null method and was originally described by J. Swinburne many years ago. Theory shows that the result found is independent of frequency and wave form. The experiments show that this is true at ordinary frequencies, the maximum inaccuracy being of the order of 1 in 5000. The authors point out minor defects of the method, mainly due to the contact difference of potential and the time taken for the preliminary adjustment. The range of the voltage that can be measured is also limited. Probably, however, if the electrometer were specially designed, these disadvantages could be got rid of, and the sensitivity of the instrument greatly increased.

Lightning.—The lecture which Dr. G. C. Simpson gave to the Junior Scientific Club of Oxford University on "Thunder and Lightning" (Oxford: Vincent Printing Works) is a very helpful contribution to our knowledge of a phenomenon which has been closely studied from the earliest ages. Naturally, there have been a very large number of theories advanced to explain the effects produced, but only two, namely, Wilson's, based on electrical induction, and Simpson's, based on the breaking up of raindrops, are mentioned. When the electric stress breaks down the air at any point, the rent made is at first very local; but once made, it rapidly extends in the form of a narrow channel. The most important characteristic of the rent is that it can only extend in the direction away from the seat of the positive electricity. As the channel extends, it tends to branch, and each branch becomes a new rent. Thus when we see a lightning discharge, we can tell from the branching which way it has extended and where the positive electricity is situated. The rate at which the lightning channel grows is usually very great. Laboratory experiments seem to indicate that it could be as fast as a tenth of the velocity of light. On the other hand, we know that in certain circumstances the channel can grow relatively slowly. The light associated with a lightning flash is due to the recombination of electrons and ions within the ionised channel. The first discharge which opens the channel leaves the air within it very highly ionised and an electrical current can pass along it. Hence it remains ionised for an appreciable time after the visible discharge has ceased. Dr. Simpson showed very interesting photographs of various abnormal types of lightning-flash. He also described two recent occurrences of ball lightning which illustrate its chief features. He confesses, however, that he does not yet see even the beginning of an explanation of it.

Condensation of Electrons on Metals.—The amount of heat liberated when an electron of zero kinetic energy is absorbed by a metal from the gas phase, a quantity of importance in connexion with the theory of electric discharges through gases, was determined several years ago by Prof. K. T. Compton and C. C. van Voorhis from an ingenious combination of micro-calorimetry with Langmuir's method for using exploring electrodes. More complete results from similar measurements, which are given in the first November number of the *Physical Review*, now establish definitely that the ionised gas from which the electrons are drawn has a specific effect on the properties of the metal surface. For platinum, for example, the heat of condensation of an electron is equivalent to 5·21 volts in the presence of nitrogen and to 4·39 volts in the presence of helium, and, moreover, contact potential differences between the exploring electrode and another of presumably constant properties change in general with time after the exploring electrode has been cleaned electrically *in situ*. It is suggested that the effect of at least the inert gases is due to their positive ions; these possess the same number of electrons as halogens, and might thus be expected to be chemically active. The permanence of any compounds formed on the metal surface is nevertheless small, since in the discharges studied it would only be necessary for each incoming positive ion to remain on the surface for one-thousandth of a second to keep ten per cent of its surface covered. This research provides a good illustration of the accuracy which can now be attained in problems connected with the electric discharge in gases, the error in the heats of condensation being believed to be well within one per cent.

Nickel as a Hydrogenation Catalyst.—Although a very large amount of work has been done on the use of nickel as a catalyst for the hydrogenation of organic compounds, systematic investigations begun by Adkins and Cramer, the first instalment of which appears in the November number of the *Journal of the American Chemical Society*, will provide much more detailed and useful information in many cases than is now available. The paper describes in a tabular form the results of experiments made with forty-five organic compounds with which satisfactory reductions were obtained. The apparatus permits of the study of the selective reduction of one of two reducible substances through the control of the temperature or time interval of reduction.

Transport of Nitrogen in the Plant.

THE general question of translocation in plants demands attention, not only because of its practical importance in horticulture, but perhaps even more so because of its intensely controversial nature. Recent work on the translocation of carbohydrates in the cotton plant, by T. G. Mason and E. J. Maskell, has already been reviewed in NATURE (123, pp. 133-135; 1929). Maskell and Mason have extended their work to the translocation of nitrogen. This work, which appears as *Memoir* 2, Series B (1930), from the Cotton Research Station, Trinidad, is as valuable a contribution to the literature of nitrogen metabolism as to that of translocation.

The experimental technique is very similar to that adopted in the work on carbohydrates; indeed, in many cases, the nitrogen analyses were made on samples which had already yielded some of the data in the earlier papers. As before, the procedure involves various ingenious combinations of ringing, partial ringing, defoliation, etc., and a rather extensive statistical analysis of analytical data obtained for the various nitrogenous fractions. It is interesting to reflect that Malpighi ringed stems in the late seventeenth century, and at least so early as 1731 such practices as ringing, partial ringing, defoliation, etc., were the staple procedures in the attempt to elucidate the "circulation or non-circulation of the sap". Stephen Hales in his "Vegetable Staticks" describes experiments in which the experimental detail seems startlingly modern. However, in his preface he found it necessary to enlighten at length those of his readers "who complain that they do not understand the signification of those short signs or characters (+; −; ×; =) which are here made use of in many of the calculations, and which are usual in Algebra". Whilst two hundred years cannot be said to have produced very outstanding modifications in experimental technique, beyond the adoption of modern analytical methods instead of fragmentary observations on growth, leaf fall, colour, etc., one can see a vast change in the method of interpreting results. Maskell and Mason make very full use of statistical methods, and apparently place a greater confidence in their readers' mathematical comprehension.

Part 1 of the paper now before us, containing observations on the downward movement of nitrogen in the stem, consists of experiments designed to test the idea that the leaf is the principal seat of protein synthesis, and its greater claim than other organs for inorganic nitrogen rests on its 'transpiration pull'. Chibnall's contention that there are diurnal changes in nitrogen (total) content of the leaf is confirmed by Maskell and Mason for the cotton plant. They find the nitrogen content higher by day than by night. Though evidence for similar changes in the bark is not so conclusive, the tentative suggestion is made that the leaf changes lead to similar concentration changes in the bark which lag somewhat behind those of the leaf. The effects of ringing on nitrogen movements are interesting relative to Curtis's suggestion that nitrogen (organic and inorganic) moves not in the xylem but in the phloem. Maskell and Mason complete their experiment 24 hours after ringing. They find that the nitrogen content of the leaf samples (3 leaves from near the apex of each of 10 plants) from ringed and normal unringed groups show normal diurnal changes and are practically identical. It is concluded that ringing has not interrupted nitrate movement, which is therefore in the wood.

This view, however, assumes that a redistribution of nitrogen between the leaves above the ring may be neglected. It is worthy of note that the sampled region is that most vigorously growing, and the possibility remains that it has drawn nitrogen, via the bark, from the lower leaves above the ring. This would be more possible in a short time experiment like the one described. Sampling of the entire leaf and stem above the ring clearly offers (in the cotton plant) considerable mechanical difficulties. The wood and bark of the ringed plants above the ring (seven inches sampled) show a significant increase in total nitrogen content, and similar samples below show a decrease. This is in harmony with the view that ringing prevents downward movement in the stem, though not that from leaf to bark. It does not necessarily indicate that there has been an upward movement of inorganic nitrogen in the wood past the ring. Curtis previously claimed (*Amer. Jour. Bot.*, 1923) that leaves of ringed twigs of lilac, privet, etc., increased in nitrogen content much less than corresponding ones of unringed plants. Maskell and Mason reinterpret one of Curtis's experiments to support the view that leaves above a ring import nitrate via the wood and export organic nitrogen via the bark. However, in the absence of data that an actual increase of total nitrogen had occurred above the ring, such an interpretation is inconclusive. Since it is known that transfer of nitrogen from one lateral branch to another does not readily take place (Auchter Agric. Expt. Stat., Univ. of Maryland, *Bull.* 257, 1923), it is improbable that the twigs in question imported organic nitrogen from the rest of the plant.

The possibility remains, therefore, that the nitrogen entering the defoliated region of stem above a ring came from the young, active leaves above it (4 pairs), whilst that entering a similar region below a ring came only from the basal leaves on that same twig (probably not more than 4 or 5 pairs), which were older, less active in protein synthesis (August), and in competition with younger leaves on other shoots for the nitrate application to the soil. Hence the seeming inconsistency referred to by Maskell and Mason, that four pairs of leaves above a ring supply to a defoliated region of stem 70 per cent as much nitrogen as the rest of the plant to a similar region below a ring, may be more apparent than real. In view of their repetition of the criticism that Curtis's results were due to transpiration effects caused by blocking of the xylem, one is reminded of the claim (*Ann. Bot.*, 1925) that complete cutting of the xylem, leaving the phloem intact, has a smaller effect on upward translocation than the reverse procedure. In another connexion Mason and Maskell have suggested, whilst admitting the significance of some of these results, the contradictory view that the superiority of the cut xylem group may be due to a few xylem elements regenerated in six days on the inner bark, whilst the inferiority of the cut phloem group may be due to plugging of the xylem. Surely if a few regenerated xylem elements are adequate, the xylem of the cut phloem group would have to be plugged to an inconceivable degree.

All this indicates the difficulty of interpreting the apparently simple ringing experiments. Many will regard the upward path of inorganic nutrients as still open to question. If Maskell and Mason are right in their contention that inorganic nitrogen moves with the transpiration stream, one is left with the curious situation that one simple solute (cane sugar) moves upward and downward in the phloem and another (inorganic nitrate) moves apparently with the water. Experiments on downward movement of nitrogen in the bark with a restricted channel of transport show that the rate per unit area increases as the available

area decreases. As suggested in the case of sugars, this is suggestive of a movement analogous to diffusion.

Part 2 of Messrs. Maskell and Mason's paper consists of observations on concentration gradients in relation to nitrogen movement. The previous work on sugar movement in the bark by the same authors showed that it was always from a region of high to one of low concentration. No such relation could be found for downward movement of nitrogen in the bark, which proceeds against a well-defined negative gradient of total and crystalloid nitrogen. All attempts to distinguish between mobile and storage forms by fractionation of the total nitrogen fail to reveal a well-defined positive gradient of any nitrogen fraction in the direction of movement, unless this be the rather elusive residual or unfractionated nitrogen. Subdivision of the bark into inner and outer zones disproved the possibility that positive and negative gradients in the different regions mask each other.

Part 3 of the paper under notice consists of an attack on the problem of movement in relation to concentration gradients by determining the change in existing nitrogen gradients caused by stoppage and reversal of nitrogen movement. The desired conditions were obtained by suitable combinations of ringing and defoliation. Unlike the situation in the case of the sugars, zero nitrogen movement is associated not with zero gradient but with a well-defined negative gradient of protein and crystalloid nitrogen. When downward movement of nitrogen is still proceeding, the negative gradient of total and crystalloid nitrogen is smaller than when movement has ceased: that is, the change from zero movement to downward movement is associated with the production of a positive gradient superimposed upon the existing negative gradient. This superimposed gradient is termed the dynamic gradient. An algebraical method of estimating the dynamic gradient, assuming a relatively constant storage gradient, is described. It is estimated that the degree of acceleration over diffusion previously found for sugars would suffice to account for the actual nitrogen movement with the observed concentration gradients (dynamic) of total nitrogen, protein nitrogen, and amino acid nitrogen. The localisation of the dynamic gradient largely in the inner bark suggests its association with the sieve tubes. It appears that the accelerating mechanism presumably associated with the sieve tubes acts impartially on sugar and nitrogen compounds. F. C. S.

Influence of Steam on the Combustion of Carbonic Oxide.

PROF. W. A. BONE, who delivered the third Liversidge Lecture before the Chemical Society on Dec. 11, chose for his subject "Fifty Years' Experimental Research upon the Influence of Steam on the Combustion of Carbonic Oxide (1880–1930)". Commencing with the late Prof. H. B. Dixon's abandonment of classics for science in 1876, Prof. Bone referred to his repetition of Bunsen's work and his observation (communicated to the British Association at Swansea in 1880) that a mixture of carbon monoxide and oxygen, if dried at the ordinary pressure over phosphorus pentoxide, becomes non-explosive when sparked in the usual way. Examination of the effect of various third substances led him to adopt the view that the action of moisture is chemical and due to the hydrogen contained in it, the pure, dry reactants being mutually inert. Moreover, the speed of flame propagation had a minimum value in the dried mixture and a maximum value in the presence of nearly 6 per cent of moisture.

The investigation was extended in 1884 by Prof. H. B. Baker, who showed that, in dry oxygen, carbon burns essentially to carbon monoxide. Prof. Bone explained the precautions necessary in such experiments, and mentioned Morley's work in 1887 and 1904; long contact of a gas with phosphorus pentoxide is unnecessary, but there is considerable difficulty in drying the surface of the containing vessel. Continuing, he referred to Traube's observations (1885) that the flame of dry carbon monoxide is extinguished by plunging it into dry air, and that when the carbon monoxide flame is directed on to ice, hydrogen peroxide may be detected; hence the scheme

$$CO + O : O + OH_2 = CO_2 + H_2O_2$$

was proposed. Mendeléeff, however, preferred the series:

$$CO + H_2O = CO_2 + H_2\,;\quad H_2 + O_2 = H_2O_2\,;$$
$$H_2O_2 + CO = CO_2 + H_2O\,;$$

and Prof. H. E. Armstrong regarded the case as one of 'reversed electrolysis'. Lothar Meyer in 1886 showed that dry, 'non-explosive' carbon monoxide and oxygen could be caused to combine non-explosively by means of a powerful discharge, indicating that direct oxidation requires a higher temperature than indirect. Beketoff postulated the necessity for the presence of oxygen atoms, which were provided by steam more readily than by oxygen molecules themselves.

Dixon's experiments in 1886 showed that in the combustion of dry cyanogen with excess of oxygen, carbon dioxide is always formed to completion, the monoxide being produced intermediately. Smithells and Dent, using the flame separator, found that the outer cone of the dry cyanogen flame will burn in air dried by sulphuric acid only if the cones are not widely separated, showing that the length of life of the carbon monoxide is a determining factor. It was confirmed in 1896 by Dixon, Strange, and Graham that the carbon monoxide, freshly formed in a dry cyanogen explosion, will combine directly with excess of oxygen in the rear of the flame front.

Dixon discounted the conclusions of Mendeléeff and of Beketoff by showing that a dry mixture of carbon monoxide and nitrous oxide does not explode when sparked, and that dry mixtures of carbon monoxide and oxygen, whether exposed to X-rays or mixed with ozone or chlorine dioxide, are equally insensitive. In 1903 Girvan demonstrated that for a given sparking device a certain degree of desiccation is necessary to prevent explosion; while in 1914 Prof. W. M. Thornton found that for given sparking conditions the igniting current for a given medium has a minimum value.

Bone and Weston (1925) studied the minimum discharge necessary to ignite a mixture of two volumes of carbon monoxide and one volume of oxygen under different conditions of water content, and obtained a hyperbolic curve. Moreover, such a mixture, completely dried in 250 days, would withstand moderate, but not heavy, discharges. The influence of hydrogen on the carbon monoxide flame had also been examined. When much is added the characteristic appearance of the flame vanishes. In the ordinary flame of carbon monoxide in oxygen direct and indirect oxidation proceed simultaneously; so-called 'steam lines' in the spectrum may be eliminated by increasing the pressure as well as by drying. A dry carbon monoxide–oxygen mixture which failed to remain in combustion was reignited while a tension of 80,000 volts was maintained between two ring electrodes 30 cm. apart in the tube. The flame slowly reached the electrodes, suddenly accelerated, and became like that of an undried mixture.

The Tercentenary of Cinchona in Medicine.

AS a nation we are much less inclined than some of our Continental neighbours to celebrate historical events. It is therefore somewhat surprising to find that the tercentenary of the introduction of cinchona bark into European medicine (see NATURE, Nov. 29, p. 850) is being commemorated in London. Dr. H. S. Wellcome, whose interest in everything that pertains to the history or the progress of medicine is well known, has arranged at the Wellcome Historical Medical Museum, 54 Wigmore Street, London, W.1, an extremely interesting exhibition of materials, manuscripts, and literature relating to this drug. The Museum itself is rich in specimens of cinchona bark of historic interest, and possesses many rare documents and books on the subject, as well as pictures of personalities who have achieved fame as explorers of the Peruvian cinchona forests, of whom Dr. Wellcome is himself an example. To this nucleus has been added for this occasion gifts and loans from governments, learned societies, and institutions in various parts of the world, with the result that never before has such a collection of material for the study of cinchona been gathered together. The exhibition will continue open for several weeks.

Among the items of general interest may be mentioned three of the original packages of cinchona bark brought from Peru by Ruiz and Pavon on their return from the expedition sent there by Carlos III. in 1777. These are shown by H.M. the King of Spain. The Secretary of State for India has contributed five blue-books and the volume of original correspondence in manuscript (1859–70) relating to Sir Clements Markham's expedition to Peru in connexion with the introduction of cinchona into India. No less interesting are some of the Museum's own treasures: for example, the original specimens of quinine and cinchonine isolated by Pelletier and Caventou in 1827, autograph letters of La Condamine and De Vrij, and the original 'permit' issued by the Peruvian Minister of Foreign Affairs to Sir Clements Markham to enable him to carry out work in the cinchona forests. For the more technical visitor there are the extensive collections of botanical material lent by the Royal Botanical Gardens, Kew; Messrs. Howard and Sons, Ltd.; the Imperial Institute, and the Pharmaceutical Society of London. Not least important is the malaria section of the Wellcome Medical Museum at Endsleigh Court, which has been transferred *en bloc* to the exhibition. The task of the visitor has been made easy by the excellent arrangement of the exhibits, the clear numbering of the specimens, and the beautifully produced catalogue.

Not content with having produced this tribute to the pioneers who discovered and brought cinchona into medical use, Dr. Wellcome arranged a series of receptions at which addresses were given by authorities on the history and uses of the drug. At the first of these, on Monday, Dec. 8, which also served as an opening ceremony, the chair was appropriately taken by Cardinal Bourne and addresses were delivered by the Ambassadors for Spain and France, whilst the Minister for Peru gave a short but interesting critical survey of the usually accepted history of cinchona. At the evening reception on the same day diplomacy and the Roman Catholic Church were still predominant, the chair being taken by the Ambassador for Holland, whilst the address was given by Cardinal Bourne's able coadjutor, Archbishop Goodier, who continued and extended the criticism of the history of cinchona as usually written. Both critics combined to demolish part of the romantic story which has been woven around the name of the Countess of Chinchon, and both declined to accept von Humboldt's statement that the natives of Peru were unaware of the virtues of cinchona.

At the receptions on Wednesday, Dec. 10, the addresses on the more technical aspects of cinchona began. In the afternoon Dr. Wellcome took the chair, whilst Sir David Prain gave the distinguished audience the fruits of his unique experience with cinchona, both as a botanist and in the capacity of a former Director of the Indian Government Cinchona Plantations, as a planter, and a quinine manufacturer. It was particularly interesting to hear this eminent authority account for the abandonment of cinchona planting in Ceylon, not by lack of enterprise or skill on the part of the British planters, but by unalterable natural causes, the chief being unsuitable soil. Sir David is also of opinion that it is unwise to devote so much attention to quinine, to the exclusion of the other cinchona alkaloids. This point was also emphasised by Prof. H. E. Armstrong, who paid a tribute to Dr. Wellcome's long-continued and generous support of chemical research, and hoped that part of the energies of the various Wellcome research institutions would shortly be devoted to solving some of the many problems which the proper and economical use of cinchona still presents for solution by chemists, pharmacologists, and clinicians.

At the evening reception the principal address was given by Sir Humphry Rolleston, who provided many interesting medical sidelights on the history of cinchona and finished with an admirable summary of the therapeutics of the drug. During the present week further receptions are being given, at which the speakers will include General Sir Charles MacWatt, formerly Director-General of the Indian Medical Service; Dr. Manson-Bahr, Dr. H. H. Dale, Dr. C. M. Wenyon, and others.

University and Educational Intelligence.

BIRMINGHAM.—The increase in number of students in the Department of Oil Engineering has necessitated the erection of additional buildings adjoining the existing Oil Block. The new buildings, which are nearly complete, include a laboratory for ordinary students, a 'large-scale' laboratory, and stores. An extension of space for research will thus become available and the congested conditions under which research work is at present being carried on will be relieved. The Department of Civil Engineering has also been extended by the erection of a large Cement Laboratory.

The Council of the University has agreed to make a contribution to the funds of the Port Erin Biological Station.

LONDON.—Applications are invited for two Keddey Fletcher-Warr studentships for the promotion of post-graduate research. Each studentship will be of the annual value of not less than £250 and tenable for three years. Application forms and further particulars may be had from the Academic Registrar, University of London, South Kensington, S.W.7, to whom completed forms must be returned by Feb. 20.

A VACATION course in photogrammetry is announced to take place in the Technical-Physical Institute of the University of Jena on Mar. 16-28 next, when lectures will be given on the elements of photogrammetry, the historical development of photogrammetry, terrestrial photogrammetry, and aerophotogrammetry. Applications for the course will be received until Mar. 1 by Mr. A. Kramer, Schützenstrasse 72, Jena, Germany.

APPLICATIONS are invited for the Theresa Seessel research fellowship of Yale University, the object of which is the promotion of original research in biological studies, and the value about £300. The holder of the fellowship must reside in New Haven during the college year, October to June. Applications should be made to the Dean of the Graduate School, New Haven, Connecticut, U.S.A., before Mar. 1.

THE thirty-first annual meeting of the Science Masters' Association will be held at Birmingham, in the University buildings, on Jan. 6–9, under the presidency of Sir Charles Grant Robertson, who will deliver his presidential address on the evening of the first day of the meeting. The programme includes lectures on the lunar landscape (Mr. J. Young), complex molecular structures (Prof. W. N. Haworth), the physicist and chemist in the petroleum industry (Prof. A. W. Nash), science education of boys up to eighteen years of age (Prof. F. W. Burstall), and zoological experiments for school work (Prof. H. Munro Fox), while the Bishop of Birmingham is to give a lecture entitled "A Finite Universe?" Mr. F. Fairbrother will open a discussion on general science, and a meeting will be held with representatives of the Commission on Educational and Cultural Films. Demonstrations will be given in the University departments of science and technology, and visits to industrial works in the locality are being arranged. There will also be a trade exhibition of books and apparatus during the meeting.

Historic Natural Events.

Dec. 21, 1581. Drought.—1581 was described as the droughtiest year that any man had known. On Dec. 21 the river Trent dried up at Alrewas, Staffordshire, on account of the lack of rain.

Dec. 22, 987. Beginning of Long Frost in Western Europe.—On this date a frost began which was said to have lasted 120 days in England. In France the autumn sowings were destroyed by the cold of winter and the drought of spring.

Dec. 22, 1664. Severe Winter and Comet.—Under this date John Evelyn records that "this year I planted the lower grove next the pond at Sayes Court. It was now exceeding cold, and a hard long frosty season, and the Comet was very visible."

Dec. 22, 1894. Gale over England.—A violent westerly gale of short duration prevailed over the whole of England, Ireland, and southern Scotland during the morning, the average velocity at Fleetwood from 8.30 to 9.30 A.M. being 79 miles per hour. The storm caused much damage on land and loss of life at sea, and sea salt was carried inland as far as Birmingham (55 miles) and Masham in Yorkshire (65 miles inland).

Dec. 25, 1739. Severe Winter in England.—The winter of 1739–40 was very rigorous, though somewhat less so than 1607–8 or 1708–9. After a cold spell on Nov. 24–30, there was a warmer interval in December, but the frost commenced on Christmas Day and continued until Feb. 17. There was a second period of cold on Feb. 23–26. At the beginning of January a high wind caused great damage to the shipping in the Thames, several ships laden with corn and coal being sunk by the sheets of drifting ice; many lives were lost. Above London Bridge the Thames was completely frozen over and a 'frost fair' was held, with sports, shops, and a printing press. An ox was roasted whole on the ice, in imitation of the ceremony in 1640. A printing press was also set up on the Ouse at York. The frost was very severe on the Continent; the Zuider Zee was completely frozen, and also the sea off Ostend. A curiosity was the palace built entirely of ice on the banks of the Neva, with six cannon made entirely of ice, one of which was actually fired without being injured. The wind over western Europe was north-easterly throughout, and there was little snow.

Dec. 25, 1923. Hail.—Intense thunderstorms occurred over the Transvaal at Pretoria and to the south-eastward. Two storms struck Pretoria, the first at 6.25 P.M. and the second at 7.30 P.M. The first storm was accompanied by hailstones, some of which weighed more than five ounces. Tiled roofs were almost totally destroyed and even galvanised iron roofs were pierced; the damage to property amounted to £80,000.

Dec. 25, 1927. Snowstorm in England.—The Christmas snowstorm of 1927 is described in *British Rainfall* as "one of the worst experienced in living memory". On Dec. 25 there was snow in the Midlands but continuous rain in the south of England. In the evening the rain changed to snow, which fell heavily over south-east England during the night and throughout Dec. 26 and the following night. It was accompanied by a strong north-easterly wind, which formed heavy drifts, some of them 20 ft. deep; many main roads were completely blocked for days and some secondary roads for weeks. Motor-cars had to be abandoned, and some were completely buried in snow. Many villages were practically cut off from the world, and a few had to be provisioned by parcels dropped from aeroplanes. On Jan. 21, 1928, six or seven feet of snow still lay in some of the Hampshire roads. The storm was most severe and the snow deepest on Dartmoor, in the Alton-Basingstoke district, and along the North Downs.

Dec. 26-30, 1906. Snowstorms in British Isles.—Snow fell heavily over the greater part of the British Isles during these five days. The depth was greatest in the south of Scotland, where numerous trains were snowed up; Aberdeen was isolated for three days, and near Arbroath a railway collision cost many lives. In Ireland the snowfall was probably the greatest on record for depth and intensity. During the same week heavy snow fell also in eastern Europe, accompanied by a high wind which caused it to accumulate in deep drifts.

Dec. 27, 1813. London Fog.—It is recorded in the *Annals of Philosophy* that between Dec. 27, 1813, and Jan. 2, 1814, "a most extraordinary fog prevailed in London, and seems to have extended a great many miles round in every direction. It was frequently so thick that it was impossible to see across the street; candles were burnt in most of the shops and counting-houses all day long. This fog condensed upon the grass, the trees, and every wooden or iron railings. The grass was covered with a coating of snow (condensed fog) at least half an inch thick. Below the trees in St. James's Park there lay a bed of snow an inch thick at least, which had fallen from them. In London the thickness of the fog was still further increased by the smoke of the city; so much so, that it produced a very sensible effect on the eyes, and the coal tar varnish might be distinctly perceived by the smell. But at a distance from town, though there was no smoke, the fog was very thick, not a breath of wind was perceptible during the whole week."

ERRATUM.

Dec. 9-11, 1672. Glazed Frost in Somerset.—The record of this phenomenon in the abridged edition of the *Philosophical Transactions*, vol. 2, p. 37, implies that the year was 1671, but Mr. C. E. Britton, of the Meteorological Office, New Ranges, Shoeburyness, from a study of the unabridged edition, states that the correct date should be 1672.

Societies and Academies.

LONDON.

Physical Society, Nov. 7.—W. N. Bond: Turbulent flow through tubes. The experimental methods included (*a*) an aural method; (*b*) photography of the motion of a deflected vane; and (*c*) injection of colour-streams about half-way along the tube. Intermittent turbulence was investigated at speeds near the critical speed, and measurements of the critical speed were made. The velocity parallel to the tube-axis is sometimes almost uniform momentarily over the transverse section. No trace was found of a simple frequency, but evidence was obtained of a predominant wave-length in the turbulent motion at the critical speed. Both these observations seem to agree with the approximate theory given by Heisenberg for flow between a pair of parallel planes.

Geological Society, Nov. 19.—A. Brammall: The Dartmoor granites: their genetic relationships (with 80 analyses by Dr. H. F. Harwood and assistants). This complex of differentiated types comprises an 'early' granite suite (sodi-potassic) and a 'late' suite (potassic). They enclose relics of an older differentiated suite (sodic) ranging from granodiorites to granites (with porphyries) and including terms which approximate to Rosenbusch's 'average alkali-granite'. These cognate inclusions are distinguished from hornfelsed xenoliths (shales and diabases). Biotites and orthoclase-phenocrysts 'vary' in the same sense as the granites themselves. The variation-curves for the whole complex show no feature that is inconsistent with a basaltic parentage. Contrary to expectations based on phase-equilibrium, the phenocrysts of the older main granites contain in solid solution a norm-plagioclase which is more albitic than the average for the containing granites. This anomaly (with some others) and the further fact that these coarse granites are the richest in accessory species suggest the effectiveness of crystal-accumulation, as postulated by Bowen. Contamination is general; hybrids are described.

Linnean Society, Nov. 20.—R. Gopala Aiyer: An account of the development and breeding habits of a brackish-water polychæt worm of the genus *Marphysa*. A species of *Marphysa* lives in the mouth of the Adyar River (Madras) and the neighbouring back-water. The mouth of the Adyar is usually closed, and the water brackish. The spawn of the worm is found mainly from February to September as jelly-like masses in which the tiny black eggs are embedded. The development of the eggs was observed in the laboratory over a period of eight months. There is no free-swimming stage. The larvæ sink to the bottom and begin a creeping existence. The creeping life is given up as new segments are added, and the tiny worms construct small tubes formed mainly of organic debris cemented together by mucus. Development takes nearly six months.

Society of Public Analysts, Dec. 3.—G. Middleton: A storage and delivery apparatus for antimony chloride solution and other corrosive reagents. Antimony chloride solution is forced upwards by means of a compression rubber bulb into a tube fitted inside the reagent bottle, whence it passes into an external measuring tube, delivering 2 c.c. into the tintometer cell. The ground-glass joints are constructed in such a manner that the reagent does not come in contact with them.—G. Middleton and F. C. Hymas: Tests for impurities in ether (2 and 3). The tests recommended for official adoption are: For acetaldehyde, modified Schiff's reagent, made by the addition of 0·1 per cent pyrogallol; and for acetone, the vanillin test of the Dutch Pharmacopœia.—Norman Evers: The determination of small quantities of calcium in magnesium salts. Dissolve the required weight of the magnesium salt in 25 c.c. of 20 per cent sulphuric acid, and add 50 c.c. of 95 per cent (by vol.) alcohol. Mix thoroughly and leave overnight. Filter on a Gooch crucible and wash with 200 c.c. of a mixture of 2 volumes of 95 per cent alcohol and 1 volume of 20 per cent sulphuric acid. Ignite and weigh as $CaSO_4$. The results obtained have a tendency to be slightly low. The method may also be applied to solutions containing phosphates, iron, etc.—P. K. Bose: A new method for the detection of nitro-groups in organic compounds. The method, which is applicable to all poly-nitro organic compounds, is based on the hydrolytic dissociation of the compound by means of potassium hydroxide, and the identification of the resulting nitrous acid by means of the Griess-Ilosvay reagent.

PARIS.

Academy of Sciences, Nov. 17.—A. Lacroix: New observations on the tectites of Indo-China. Tectites have been found in large numbers over a distance of 1300 kilometres in Indo-China. Their chemical composition is constant. The possible origin of these tectites is discussed: volcanic origin, genesis in the place found, are both impossible, and a cosmic origin appears probable.—André Blondel: The practical magnetic units.—Georges Claude: Concerning a communication of M. Raveau.—R. Nasini: The discovery of boric acid in the glaze of Arezzo vases. The presence of borax in these Roman glazes of the first century has been suggested, but not proved. By the analyses of authenticated specimens it is now established that this red glaze contains boric acid, not as occasional traces but as a true constituent.—Charles Porcher was elected *Correspondant* for the Section of Rural Economy in succession to the late Ulysse Gayon.—E. Halphen: The extension of Chasles's theorem to space.—N. Achieser: The asymptotic properties of some polynomials.—A Kolmogoroff: The law of large numbers.—Mlle. Marie Charpentier: The existence of Peano points of a differential equation of the first order.—Rolf Nevanlinna: A class of transcendental functions.—J. Delsarte: The determination of the Taylor coefficients of a probability function the moments of which are known.—Jos. Kaucký: Remarks on the note of M. V. Romanovsky. The discrete chains of Markoff.—Julius Wolff: The angular derivative.—Couffignal: A new calculating machine.—D'Ocagne: Remarks on the preceding note.—J. Ph. Lagrula: The position error of the centre of dependences at the interior of a triangle of reference, when the homology is assimilated to linear homography.—James Basset: An apparatus for experimenting on gases at ultra-pressures of 6000 kgm. per square centimetre. Description with a photograph and two diagrams of the apparatus.—E. Brylinski: A system of mechanical, electrical, and magnetic units.—Panc-Tcheng Kao: The relaxation oscillations produced by an oscillator with piezo-electric quartz.—R. Weil: New observations on quartz.—A. Dauvillier: The X-ray spectra of gases. The *K* series of krypton and xenon.—P. Lebeau and A. Damiens: The action of fluorine upon wood charcoal. The boiling point and melting point of carbon tetrafluoride. The gas obtained by the action of fluorine upon wood charcoal, after freeing from oxygen and moisture, is liquefied by cooling to −190° C. By fractional distillation of this liquid, pure carbon tetrafluoride has been prepared, with a boiling point of −126° C. and melting point −191° C. From the heavier fractions two other gases have been isolated, hexafluor ethane, C_2F_6, and octafluor propane, C_3F_8, and these are being further studied.—M. Paić:

The X-ray study of the products obtained by the action of the halogen acids on the mercuric sulphates. Fusion diagram of the system HgI_2-$HgSO_4$.—**Sou Phou Ti**: The action of ethylmagnesium bromide on *N*-diethylmonochloracetamide. This reaction took an unexpected course, the main product being an amino-alcohol, probably $Et_2N . CEt_2 . CH_2OH$. A trace of diethylacetaldehyde was also isolated.—**J. Décombe**: The *N*-alkylation of the β-amino-ethers.—**Mlle. S. Grateau**: A new method of preparing the δ-ketonic esters. The Friedel and Crafts reaction applied to the chloride ester of adipic acid gives an excellent yield of ethyl δ-benzoylvalerate, and the reduction of this ester leads to phenylcaproic acid. The method appears to be capable of general application.—**Frèrejacque**: A catalyst for the autoxidation of uric acid. In presence of activated carbon, uric acid is completely oxidised in alkaline solution by oxygen, giving a mixture of allantoin and oxonamide.—**A. Travers and Franquin**: The extraction of the bases from the condensation liquors of primary tar.—**Maurice Blumenthal**: The structure of the penibetic chain between Antequera and Loja (Andalusia).—**Jacques Bourcart**: An attempt at the co-ordination of the observations on the stratigraphy of the Atlantic slope of the Djebalas peninsula (Northern Morocco).—**Mlle. Eliane Basse**: Geological observations on the fossil-bearing secondary formation outcropping between Onilahy and Fiherenana (South-West Madagascar).—**Albert Nodon**: The humming of aerial lines and atmospheric disturbances. The methodical study of the humming of conducting wires, assisted by an amplifying arrangement, can give information valuable for weather forecasts.—**J. Bosler**: The relations between magnetic storms and the earth currents.—**J. Magrou and Mme. M. Magrou**: Actions exerted at a distance on the fertilised egg, the sperm, and the virgin egg of the sea-urchin, *Paracentrotus lividus*.—**H. Bordier and C. Boisson**: A new application of d'Arsonvalisation: hydrodiathermotherapy.—**F. Rosenbusch**: A disease of Paraguay cattle, similar to paralytic rabies.

LENINGRAD.

Academy of Sciences, *Comptes rendus*, No. 16, 1930.—**S. Bernstein**: Some remarks on the polynoms of the minimum deviation with whole coefficients.—**V. Kistiakovskij**: The problem of metastable flotation.—**N. Willams**: The action of the nitric acid on the primary tetrahydro-α-furfurilamine.—**I. Kurbatov**: Conditions of growth of crystals of slightly soluble substances.—**B. Licharev**: Two new representatives of the family Productidæ from the Lower Permian of North Caucasus. Descriptions of *Loczyella* (?) *parvula*, sp. n., and *Pectenoproductus proprius*, gen. and sp. n.

Comptes rendus, No. 17, 1930.—**P. Lazarev**: Action of certain substances on the nervous centres. General theoretical considerations.—**P. Lazarev and A. Dubinskaja-Voskresenskaja**: Objective studies of nervous centres in persons suffering from *paralysis progressiva*, after the application of salvarsan and of X-rays. Determinations of the increase in the sensibility of eyes supply a method for observing objectively the action of X-rays and of salvarsan.—**P. Lazarev and L. Kuper**: Action of acoustic excitations on the sensibility of the eye. The peripheral sensibility decreases under the influence of sounds.—**N. Demjanov**: Action of nitric anhydride on the ethylenic hydrocarbons.—**I. Kurbatov**: The proportions of some active elements in the dispersion rocks of Tuia-Mouium.—**V. Gromova**: The type of *Bison priscus* Bojanus. A specimen from Siberia in the collection of the Zoological Museum of the Academy is redescribed as the type.—**N. Jakovlev**: The discovery of the anal proboscis in the genus *Cupressocrinus*.—**A. Vinogradov**: Vanadium in marine organisms. The concentration of vanadium in the ascidian *Phallusia obliqua* may be up to 0·0302 per cent of the live weight.—**P. Schmidt and G. Lindberg**: A new Japanese fish, *Paracanthochaetodon modestus*, gen. and sp. n.

PRAGUE.

Czech (Bohemian) Academy of Arts and Sciences (second class, Natural Sciences and Medicine), Oct. 17.—**J. Wolf**: The origin of fibrillar collagenic sols. Fibrillar sols of the synovia.—**L. Borovanský**: A contribution to the study of growth of organs during the fœtal period.—**V. Hovorka**: Reaction of iodic acid with phosphorous and hypophosphorous acid. In acidic medium, hypophosphorous acid is easily oxidised to phosphorous acid; in alkaline solution iodates are reduced only by hypophosphites. In presence of argentous and mercuric salts the reactions are complicated.—**V. Kořinek**: Quadratic bodies of quaternion orbits.—**J. Koutský**: A study of asymptotic transformations of undevelopable surfaces in projective S_3.—**R. Lukeš**: The action of Grignard's agent on *N*-methyl-pyrrolidon. Grignard's agent of methyl-, ethyl-, *n*-propyl-, and phenyl-bromides acting on *N*-methyl-pyrrolidon yielded 1-methyl-2 alkyl-Δ_2 pyrrolines, which were isolated as perchlorates, and the corresponding 1-methyl-2·2 di-alkyl-pyrrolidines. The aromatic agent gave 1-methyl-2-phenyl-Δ_2-pyrroline.—**V. Prelog**: The sapogenin of beetroot. The oxidation of sapogenin ($C_{31}H_{50}O_3$) by chromic acid yielded a ketonic acid, $C_{31}H_{48}O_3$, giving a methylester, a semicarbazone, and a keto-hydroxy-lactone, $C_{31}H_{46}O_4$. The carboxyl is bound to a tertiary carbon atom and the substance contains inert double-linkages.—**K. Šimek**: The graphical solution of reactions and axial forces for special plain systems of poles.—**J. Petrbok**: Pleistocene molluscs of the Danube terrace near Russe in Bulgaria.—**V. Posejpal**: A third contribution to the study of universal ether. From his conception of particles of ether, the radius, r, of which should be identical with that of an electron, the author deduces the diffusion coefficient σ/ρ of hydrogen for very hard γ-rays as $\frac{\delta}{\rho} = \frac{\pi}{m_H} r^2$, where m_H is the absolute mass of a hydrogen atom. The radius of the ether particle thus calculated agrees well with the value derived for the radius of the electron from the electro-magnetic theory of mass.—**J. M. Jaeger**: Molecular configuration and optical activity. Methods, results, and problems of precise modern measurements of high temperatures. Constitution and structure of ultramarine.—**C. Purkyně**: The waterfall of river Zambezi.

Nov. 14.—**E. Votoček**: Osazonogenic groups. From original experiments and literature the osazonogenic grouping is shown to be more general, extending to groups like $-CO.CH_2Cl$, $-CO.CHCl_2$, $C-CHCl-CO-$, and many others.—**F. Valentin**: A new form of the two rhamnite antipodes. The two optical isomerides, rhamnite trihydrates, $C_6H_{14}O_5.3H_2O$, are enantiomorphous, according to Pasteur's rule.—**J. Babička**: The determination of proteins by means of electrolysis with the dropping mercury cathode. In the presence of ammonium salts solutions containing soluble proteins (ovo-albumin, serum-albumin, hæmoglobin, phyto-albumin) the electrolytic current-voltage curves, registered polarographically, show an electro-reduction at −1·5, −1·7 volt. The increase of current at this cathodic potential is proportional to the amount of soluble protein. Qualitative and quantitative estimation of albumins is thereby possible.—**R. Nováček**: Linnéit from the mine Prago at Kladno.—**V. Tůma**: On the process of closing umbilical blood vessels during human birth.—**J. Matiegka and J. Malý**: The bodily remains of Karel Havlíček Borovský.

Official Publications Received.

BRITISH.

Mathematical Notes: a Review of Elementary Mathematics and Science. Edited by William Arthur. No. 26, October. Pp. xxii. (Edinburgh: Edinburgh Mathematical Society.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), Nos. 40-47. 40: The Nitration of Substituted Diaryl Ethers:—Phenyl-P-Tolyl Ether, by Joseph Reilly, P. J. Drumm and T. Gray; 41: Study of the Polysaccharides, Part 3: Acetamide as a Polysaccharide Solvent, by J. Reilly, Dr. Reinhold Wolter and P. P. Donovan; 42: Report of the Irish Radium Committee for the Year 1929, including Reports by Oliver Chance, Andrew Charles, Oswald J. Murphy, Dr. Walter C. Stevenson, C. M. Taylor, Josephine Walsh; 43: The Raised Beaches of the East Coast of Ireland, by C. P. Martin; 44: *Paecilomyces hibernicum*—New Species, by C. V. E. Kennelly and M. Grimes; 45: Photo-electric Measurements of Illumination in relation to Plant Distribution, Part 3: Certain Spruce, Larch, Oak and Holm Oak Woods, by Dr. W. R. G. Atkins and Florence A. Stanbury; 46: The Distribution of Pasture Plants in relation to Soil Acidity and other Factors, by Dr. W. R. G. Atkins and E. Wyllie Fenton; 47: A Study of Fungi found in Butter, by M. Grimes and V. C. E. Kennelly and H. A. Cummins. Pp. 461-569+plates 19-23. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 8*s*.

Proceedings of the Royal Society. Series A, Vol. 129, No. A811, November 3. Pp. 411-698+xxxviii. (London: Harrison and Sons, Ltd.) 15*s*.

Proceedings of the Malacological Society of London. Edited by R. Winckworth. Vol. 19, Part 3, November. Pp. 83-155 + plates 9-17. (London: Dulau and Co., Ltd.) 10*s*. net.

Transactions of the Edinburgh Geological Society. Vol. 12, Part 3. Pp. 289-304. (Edinburgh.) 1*s*.

Report on the Administration of the Museum and Public Gardens during 1104 M.E. Pp. 15. (Trivandrum.)

Conference of Directors of Far Eastern Weather Services, Hong Kong, 1930. Report of Proceedings, with Appendices and List of Delegates. Pp. ii+69. (Hong Kong: Royal Observatory.)

Department of Agriculture, Straits Settlements and Federated Malay States. Scientific Series No. 2: Investigations on Panama Disease in Malaya. By F. S. Ward. Pp. iii+26+4 plates. 1 dollar. Scientific Notes No. 3: An Historical Note on *Tirathaba rufivena* Walk. (The Greater Coconut Spike Moth) and its three Parasites in Malaya, by G. H. Corbett; Preliminary Observations on *Sogata* spp. Pests of Padi, by N. C. E. Miller and H. T. Pagden. Pp. 14. 50 cents. (Kuala Lumpur.)

Report of the Botanical Survey of India for 1928-29. Pp. 9. (Calcutta.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1328 (E. 38): Performance of a Compression Ignition Unit with Reduced Intake and Exhaust Pressures. By P. H. Stokes. (I.C.E. 742 A. and B.) Pp. 20+21 plates. 1*s*. 6*d*. net. No. 1332 (Ae. 464): Comparative Handling Tests of three Bristol Fighter Aircraft with different Types of Slots. By Flight-Lieut. C. E. Maitland and Flight-Lieut. J. H. C. Wake. (S. and C. 331.) Pp. 8+9 plates. 9*d*. net. No. 1335 (Ae. 466); Photographic Records of Flow in the Boundary Layer. By L. F. G. Simmons and N. S. Dewey. (T. 2958.) Pp. 9+6 plates. 1*s*. net. No. 1336 (E. 40): The Application of Dimensional Relationships to Air Compressors, with Special Reference to the Variation of Performance with Inlet Conditions. By R. S. Capon and G. V. Brooke. (I.C.E. 762.) Pp. 22+9 plates. 1*s*. 3*d*. net. (London: H.M. Stationery Office.)

University of Cambridge: Solar Physics Observatory. Eighteenth Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1929 August 1–1930 July 31. Pp. 5. (Cambridge.)

The Association of Engineering and Shipbuilding Draughtsmen. Diary 1931. Pp. 110+Diary. (London: The Draughtsman Publishing Co., Ltd.)

Public Library, Museum and Art Gallery of South Australia. Records of the South Australian Museum, Vol. 4, No. 2. Pp. 145-273. (Adelaide.) 10*s*. 6*d*.

Proceedings of the Royal Society of Edinburgh, Session 1929-1930. Vol. 50, Part 3, No. 21: The Climate during the Pleistocene Period. By Dr. G. C. Simpson. Pp. 262-296. 3*s*. Vol. 50, Part 3, No 22: The Metabolism of the Frog's Isolated Heart. By Prof. A. J. Clark, Dr. C. P. Stewart and R. Gaddie. Pp. 297-303. 9*d*. Vol. 50, Part 3, No. 23: On some Persymmetric Determinants. By J. Geronimus. Pp. 304-309. 9*d*. Vol. 50, Part 3, No. 24: The General Form of the Orthogonal Polynomials for Simple Series, with Proofs of their Simple Properties. By F. E. Allan. Pp. 310-320. 1*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The British Institute of Radiology, incorporated with the Röntgen Society. Year Book 1930. Pp. 72. (London.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 68, No. 407, November. Pp. 1369-1539+xxxii. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

Journal of the Royal Society of Western Australia. Vol. 15, 1928-1929. Pp. xlv+131. (Perth.) 35*s*.

Ministry of Transport and Ministry of Agriculture and Fisheries: Joint Committee on Damage to Fisheries. Detailed Biological and Chemical Reports on Tars used for Road-Surfacing. Pp. 171. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

New Zealand: Department of Lands and Survey. Scenery-Preservation: Report for the Year ended 31st March 1930, together with Statement of Accounts and Schedule of Lands acquired and reserved during the Year under the Scenery Preservation Act. Pp. 30+8 plates. (Wellington, N.Z.: W. A. G. Skinner.)

New Zealand. Tongariro National Park: Annual Report of the Board. Pp. 7. (Wellington, N.Z.: W. A. G. Skinner.) 6*d*.

Trinidad and Tobago. Minutes and Proceedings of the Froghopper Investigation Committee. Part 9. Pp. 81-192. (Trinidad, B.W.I.: Government Printing Office, Port-of-Spain.)

The Royal Technical College, Glasgow. Annual Report on the One Hundred and Thirty-fourth Session adopted at the Annual Meeting of Governors held on the 21st October 1930. Pp. 79. (Glasgow.)

Canada. Department of Mines: Mines Branch. Investigations of Fuels and Fuel Testing (Testing and Research Laboratories) 1928. (No. 712.) Pp. ii+71+2 plates. (Ottawa: F. A. Acland.)

Tide Tables for the Eastern Coasts of Canada for the Year 1931: including the River and Gulf of St. Lawrence, the Atlantic Coast, the Bay of Fundy, Northumberland and Cabot Straits, and Information on Currents; in addition Tide Tables for New York and Boston, U.S.A. Issued by the Tidal and Current Survey Division of the Hydrographic Service, in the Department of Marine and Fisheries of the Dominion of Canada. Thirty-fifth Year of Issue. Pp. 92. (Ottawa: F. A. Acland.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1303 (E. 39): Torsional Vibration of Crankshafts. Beardmore 'Tornado' Airship Engine Investigations. By B. C. Carter and N. S. Muir. (T.V.C. 44 and 50.) Pp. 56+10 plates. (London: H.M. Stationery Office.) 3*s*. net.

Memoirs of the Geological Survey of India. Vol. 56: The Jharia Coal Field. By Dr. C. S. Fox. Pp. vi+255+vii+21 plates. (Calcutta: Government of India Central Publication Branch.) 8.12 rupees; 14*s*.

Records of the Geological Survey of India. Vol. 63, Part. 3. Pp. 281-377. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5*s*.

The British Mycological Society. Transactions. Edited by Carleton Rea and J. Ramsbottom. Vol. 15, Parts 1 and 2, 15 November. Pp. 192. (London: Cambridge University Press.) 15*s*.

Tide Tables for the Pacific Coast of Canada for the Year 1931: including Fuca Strait, the Strait of Georgia and the Northern Coast; with Data for Slack Water in the Navigable Passes and Narrows and Information on Currents; also Tide Tables for the U.S. Ports of Seattle and Port Townsend. Issued by the Tidal and Current Survey Division of the Hydrographic Service, in the Department of Marine and Fisheries of the Dominion of Canada. Thirty-first Year of Issue. Pp. 80. (Ottawa: F. A. Acland.)

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 2, No. 2, September. Compiled by Agnes Elisabeth Glennie. Pp. iv+89. (London: H.M. Stationery Office.) 2*s*. net.

London University Guide and University Correspondence College Calendar, 1931–1932. Pp. 217. (Cambridge and London: University Correspondence College.) 2*s*. 6*d*.

The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1929–30. Pp. 30. (Aberdeen.)

Summary and Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1929. Part 3. Pp. iv+89+8 plates. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

Report of the Department of Industries, Madras, for the Year ending 31st March 1930. Pp. vi+122. (Madras: Government Press.) 12 annas.

The University of Manchester: The Manchester Museum. Museum Publication 99: Report of the Museum Committee for the Year 1929–30. Pp. 27. 6*d*. net. Museum Publication 100: Notes from the Manchester Museum, No. 33: Three Manchester Botanists, Leopold Hartley Grindon, Charles Bailey, James Cosmo Melvill. (Course of Museum Lectures delivered November–December 1929.) By Prof. F. E. Weiss. Pp. 20+3 plates. 2*s*. 6*d*. (Manchester.)

Jubilee Congress of the Folk-Lore Society, Sept. 19–Sept. 25, 1928. Papers and Transactions. Pp. 319+5 plates. (London: William Glaisher, Ltd.) 21*s*. net.

Board of Education. Report on the Science Museum for the Year 1929. Pp. 27. (London: H.M. Stationery Office.) 6*d*. net.

North-East Coast Institution of Engineers and Shipbuilders. List of Members, 1st August 1930. Pp. 48. (Newcastle-upon-Tyne.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 3 (New Series), No. 10, October. Abstracts Nos. 1854-2038. Pp. 341-378. (London: H.M. Stationery Office.) 9*d*. net.

Royal Agricultural Society of England. Agricultural Research in 1929. Pp. viii+182. (London: John Murray.) 1*s*.

FOREIGN.

The Rockefeller Foundation. Annual Report, 1929. Pp. viii+402. (New York City.)

Bulletin of the American Museum of Natural History. Vol. 60: The Birds of Matto Grosso, Brazil; a Report on the Birds secured by the Roosevelt-Rondon Expedition. By Elsie M. B. Naumburg, with Field Notes by George K. Cherrie. Pp. vii+432+17 plates. (New York City.)

Proceedings of the United States National Museum. Vol. 78, Art. 9: American Two-winged Flies of the Genus *Stylogaster* Macquart. By J. M. Aldrich. (No. 2852.) Pp. 27. (Washington, D.C.: Government Printing Office.)

U.S. Department of Agriculture. Miscellaneous Publication No. 86: Outlines for Studies of Mammalian Life Histories. By Walter P. Taylor. Pp. 12. (Washington, D.C.: Government Printing Office). 5 cents.

Scientific Publications of the Cleveland Museum of Natural History. Vol. 1, No. 3: A new Genus of African Starlings. By Harry C. Oberholser. Pp. 81-82+plate 17. (Cleveland, Ohio.)

Ministry of Public Works, Egypt: Physical Department. Further Experiments on the Discharge of Models of Sluices. By Dr. H. E. Hurst. (Physical Department Paper No. 25.) Pp. iii+23+19 plates. (Cairo: Government Press.) 10 P.T.

Suomen Geodeettisen Laitoksen Julkaisuja: Veröffentlichungen des Finnischen Geodätischen Institutes. No. 13: Relative Bestimmungen der Schwerkraft in Finnland in den Jahren 1926-1929. Von U. Pesonen. Pp. 168. No. 14: Anwendung der Lichtinterferenz bei Basismessungen. Von Prof. Y. Väisälä. Pp. 47. (Helsinki.)

United States Department of Agriculture: Weather Bureau. Monthly Weather Review, Supplement No. 34: The Daily, Monthly and Annual Normals of Precipitation in the United States, based on the 50-Year Period, 1878–1927 inclusive. By P. C. Day. Pp. 101. (Washington, D.C.: Government Printing Office.) 35 cents.

The Museum of the Brooklyn Institute of Arts and Sciences. Science Bulletin, Vol. 4, No. 1: Maya Dates and what they Reveal; a Re-examination of the Evidence in Correlation between Central American and European Time Counts. By Herbert J. Spinden. Pp. 111. (Brooklyn, N.Y.)

State of Illinois. Department of Registration and Education: Division of the Natural History Survey. Classified List of Publications available for Exchange and Distribution, including the Publications of the State Entomologist's Office and the State Laboratory of Natural History. Pp. 30. Bulletin, Vol. 18, Art. 3: Epidemic Diseases of Fruit Trees in Illinois, 1922–1928. By L. R. Tehon and Gilbert L. Stout. Pp. 411-502. Bulletin, Vol. 19, Art. 1: The Fishes of Champaign County: a Study of the Distribution and Abundance of Fishes in Small Streams. By David H. Thompson and Francis D. Hunt. Pp. 101. Bulletin, Vol. 19, Article 2: Records of Spring Migration of Birds at Urbana, Illinois, 1903–1922. By Frank Smith. Pp. 103-117. (Urbana, Ill.: State Natural History Survey.)

Cornell University Agricultural Experiment Station. Bulletin 507: Motor Trucks on New York Farms. By C. W. Gilbert. Pp. 55. Memoir 132: Biochemistry and Biophysics of the Developing Hen's Egg. 1: Influence of Humidity. By Alexis L. Romanoff. Pp. 27. (Ithaca, N.Y.)

Proceedings of the United States National Museum. Vol. 77, Art. 19: Notes on the Rhinotragine Beetles of the Family Cerambycidae, with Descriptions of New Species. By W. S. Fisher. (No. 2842.) Pp. 20. Vol. 77, Art. 20: The Taxonomy and Host Relationships of the Biting Lice of the Genera Dennyus and Eureum, including the Descriptions of a New Genus, Subgenus and four New Species. By H. E. Ewing. (No. 2843.) Pp. 16. (Washington, D.C.: Government Printing Office.)

Publikationer fra det Danske Meteorologiske Institut. Communications magnétiques, etc. No. 11: Le variomètre de Copenhague, par D. la Cour et Viggo Laursen; No. 12: On the Scale Value and the Base Value of the H-Variometer, by V. H. Ryd. Pp. 11+11. (København: G. E. C. Gad.)

Publications de l'Observatoire Astronomique de l'Université de Belgrade. Tome 3: Annuaire pour l'an 1931. Rédigé par V. V. Michkovitch. Pp. 146+3 planches. (Belgrade.)

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 271-273: A Study on the Decomposition of Potassium Ferrocyanide and of Potassium Ferricyanide by the Autoclave Treatment, by Tominosuke Katsurai and Tokunosuke Watanabe; Researches on the Cutting Force, 2: Cutting Action of Planing Tool, by Makoto Okoshi; Grain-Growth of Marble (Abridgement), by Masawo Kuroda. Pp. 189-227. (Tōkyō: Iwanami Shoten.) 75 sen.

Mount Wilson Catalogue of Photographic Magnitudes in Selected Areas 1-139. By F. H. Seares, J. C. Kapteyn and P. J. van Rhijn, assisted by Mary C. Joyner and Myrtle L. Richmond. (Papers of the Mount Wilson Observatory, Vol. 4.) (Publication No. 402.) Pp. 1+276. (Washington, D.C.: Carnegie Institution.) 8.00 dollars.

Contributions to Palaeontology from Carnegie Institution of Washington. 1: A Neocene Erosion Surface in Central Oregon, by John P. Buwalda; 2: The Dalles and Hood River Formations, and the Columbus River Gorge, by John P. Buwalda and Bernard N. Moore; 3: Oreodonts from the Sespe Deposits of South Mountain, Ventura County, California, by Chester Stock; 4: Carnivora New to the Mascall Miocene Fauna of Eastern Oregon, by Chester Stock; 5: Capromeryx minor Taylor from the McKittrick Pleistocene, California, by Eustace L. Furlong; 6: A Tertiary Vertebrate Fauna from the Upper Cuyama Drainage Basin, California, by C. Lewis Gazin; 7: A Tertiary Mammalian Fauna from the Mint Canyon Formation of Southern California, by John H. Maxson. (Publication No. 404.) Pp. iii+112+8 plates. (Washington, D.C.: Carnegie Institution.) 2.25 dollars.

Contributions to Embryology. Vol. 21, Nos. 118 to 125. 118: A Human Embryo with Seventeen Pairs of Somites, by Wayne J. Atwell; 119: Description of a Human Embryo with Eight Somites, by Cecil M. West; 120: Medullated Tracts in the Brain Stem of a Seventh-month Human Fetus, by O. R. Langworthy; 121: Ossification of the Otic Capsule in Human Fetuses, by T. H. Bast; 122: On an Unusual Placental Form in the Hyracoidea, its Bearing on the Theory of the Phylogeny of the Placenta, by George B. Wislocki; 123: Gross and Microscopic Structure of Thyroid Gland in Man, by W. F. Reinhoff, Jr.; 124: The Age Factor in Grafts, by Vera Danchakoff and V. E. Danchakoff; 125: The Early Embryology of the Rabbit, by P. W. Gregory. (Publication No. 407.) Pp. iii + 168 + 29 plates. (Washington, D.C.: Carnegie Institution.) 3.75 dollars.

Thermodynamic Relations in Multi-Component Systems. By Roy W. Goranson. (Publication No. 408.) Pp. xvii+329. (Washington, D.C.: Carnegie Institution.) 6.00 dollars.

Leonardo da Vinci, the Anatomist (1452–1519). By Prof. J. Playfair McMurrich. (Published for the Carnegie Institution.) (Publication No. 411.) Pp. xx+265+72 plates. (Baltimore, Md.: Williams and Wilkins Co.) 6.00 dollars.

Report of the Aeronautical Research Institute, Tōkyō Imperial University. No. 63: The Attempted Take-off of the "City of Tacoma" for the Trans-Pacific Flight at Kasumigaura, Japan. By Taitiro Ogawa. Pp. 249-259+2 plates. (Tōkyō: Koseikai Publishing House.) 0.16 yen.

Proceedings of the United States National Museum. Vol. 77, Art. 12: Birds from the Small Islands off the Northeast Coast of Dutch Borneo. By J. H. Riley. (No. 2835.) Pp. 23 + 1 plate. (Washington, D.C.: Government Printing Office.)

U.S. Department of Agriculture. Circular No. 139: Method and Procedure of Soil Analysis used in the Division of Soil Chemistry and Physics. By W. O. Robinson. Pp. 20. (Washington, D.C.: Government Printing Office.) 5 cents.

U.S. Department of Commerce: Coast and Geodetic Survey. Serial No. 482: Results of Magnetic Observations made by the United States Coast and Geodetic Survey in 1929. By Daniel L. Hazard. Pp. 33. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the American Philosophical Society. Vol. 69, No. 7. Pp. 397-528. (Philadelphia.)

Ministère de l'Instruction publique et des Beaux-Arts. Enquêtes et documents relatifs à l'enseignement supérieur. 124: Rapports sur les Observatoires astronomiques de province et les Observatoires et Instituts de Physique du Globe, année 1928. Pp. 115. (Paris: Imprimerie Nationale.)

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Mémoire No. 45: Hydromedusae collected in the South-Western Part of the North Sea and in the Eastern Part of the Channel in 1903-1914. By P. L. Kramp. Pp. 55. (Bruxelles.)

An Album of the Groups in the Verney-Faunthorpe Hall of South Asiatic Mammals of the American Museum of Natural History. Pp. 28+24 plates. (New York City.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 5, No. 4, October. Pp. 781-972. (Washington, D.C.: Government Printing Office.)

Reprint and Circular Series of the National Research Council. No. 94: Eighth Report of the Committee on Contact Catalysis. By J. C. W. Frazer. Pp. 51. 50 cents. No. 95: Doctorates conferred in the Sciences by American Universities, 1929–1930. Compiled by Callie Hull and Clarence J. West. Pp. 49. 50 cents. No. 96: Second Report of the Committee on Photochemistry. By Hugh S. Taylor. Pp. 45. 50 cents. (Washington, D.C.: National Academy of Sciences.)

State of California: Division of Fish and Game. Fish Bulletin No. 23: Success of the Purse Seine Boat in the Sardine Fishery at Monterey, California (1929–1930 Fishing Season). By J. B. Phillips. Pp. 30. Free. Fish Bulletin No. 24: An Analysis of the Catch Statistics of the Striped Bass (*Roccus lineatus*) Fishery of California. By J. A. Craig. Pp. 43. Free. Fish Bulletin No. 25: Fishing areas along the California Coast for the Sardine (*Sardinia caerulea.*) By the California State Fisheries Laboratory. Pp. 46. Free. Fish Bulletin No. 26: Seasonal Changes in the Daily Average Length of the California Sardine (*Sardinia caerulea*). By Frances N. Clark. Pp. 22. Free. (Terminal Island, Calif.: California State Fisheries Laboratory.)

Annual Report of the Board of Regents of the Smithsonian Institution showing the Operations, Expenditures and Condition of the Institution for the Year ending June 30, 1929. (Publication 3034.) Pp. xiii+622+91 plates. (Washington, D.C.: Government Printing Office.) 1.75 dollars.

Diary of Societies.

FRIDAY, DECEMBER 19.

LONDON SOCIETY (at Royal Society of Arts), at 5.—Prof. S. D. Adshead: South Essex: Its Docks, Industries, and Houses.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Informal Meeting) (in Mining Institute, Newcastle-upon-Tyne), at 7.15.—E. L. Champness and others: Are we justified in using Steel and other Materials of Foreign Manufacture in the British Engineering Industries?

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. Cullen: Well Drill Blasting.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION (at Royal Society of Arts), at 7.30.—R. C. Hawkins: Sales Aspects of Hotel Lighting.

JUNIOR INSTITUTION OF ENGINEERS (at Metallurgical Club, Sheffield), at 7.30.—P. S. Devereux: Chairman's Address.

INSTITUTE OF CHEMISTRY (London Section), at 8.—Dr. A. E. Dunstan: Gluckstein Memorial Lecture.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics and Comparative Medicine Sections), at 8.30.—Major A. A. Pryer, Dr. R. W. A. Salmond, Lieut.-Col. E. Middleton Perry, Dr. J. B. King, and others: Discussion on A Comparison of Radiological Problems in Man and Animals.

SOCIETY OF DYERS AND COLOURISTS (London Section).—Dr. Callan: Emulsifying Agents, Textile Assistants, and Finishing Materials: their Examination and Valuation.

MONDAY, DECEMBER 22.

INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at 39 Elmbank Crescent, Glasgow), at 7.30.—Dr. H. E. Merritt: Trends in the Transmission.

PUBLIC LECTURE.

FRIDAY, DECEMBER 19.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—J. Pryde: Human Engines.

CONFERENCE.

DECEMBER 19 AND 20.

SOCIETY FOR EXPERIMENTAL BIOLOGY (at Bedford College).

Friday, *Dec.* 19, 10 A.M. to 1.—Dr. M. C. Rayner: Observations on *Armillaria mellea* in Pure Culture with Certain Conifers.

J. G. Boswell: The Biochemistry of Dry Rot in Wood.

G. E. Blackman: The Effect of Nitrogen Compounds on the Botanical Composition of Grass.

Dr. W. H. Pearsall: Changes in the Constitution of *Beta* Leaves during Growth.

Dr. E. D. Adrian: The Activity of Isolated Nerves and Nerve Cells.

H. O. Bull: Conditioned Responses and Salmon Smolts.

2.15 to 4.—Dr. C. M. Yonge: The Relationship between Corals and Zooxanthellæ.

Dr. T. A. Stephenson: The Growth of Corals.

E. Hindle: Thermophilous Organisms.

W. H. Thorpe: Experiments on the Biology of the Petroleum Fly, *Psilopa petrolii*.

5.30 to 6.30.—E. Charles: Metabolic Changes associated with Pituitary Activity.

E. A. Spaul: Internal Secretions and Metamorphosis.

Saturday, *Dec.* 20, 10 A.M. to 1.—Symposium on the Permeability of Protoplasmic Membranes.

Prof. L. T. Hogben: Electrical Conductivity and the Permeability of Animal and Plant Tissues.

Prof. A. V. Hill: The Steady State across Biological Membranes.

A. D. Hobson: Changes in the Sea-Urchin Egg following Fertilisation.

R. J. Pumphrey: Electrical Potentials across the Membranes of the Trout Egg.

C. F. A. Pantin: Surface Permeability and the Evolution of the Blood Serum.